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DIRECT-CURRENT MOTORS.

While the design of electrical machinery is abundantly covered in books, the operating characteristics of such machinery has had meagre treatment, notwithstanding the fact that for 1000 men who operate dynamos and motors, there are perhaps not a dozen engaged in their design. There are, it is true, a number of so-called "practical books for practical men" which profess to treat of the operation of electrical machinery, but these when not merely perfunctory compilations, are usually based only on the limited personal experience of the writer. A notable exception as a practical treatise is "The Management of Dynamos and Motors," by Crocker and Wheeler, which owes its great success to the fact that the information conveyed is associated with the principles of the apparatus considered, whereby the reader's understanding of the subjects presented is broadened and practical deductions are firmly impressed on his mind. With this issue we begin the publication of a series of articles written by Prof. F. B. Crocker, one of the authors of the book above mentioned, in collaboration with Prof. Morton Arendt, which work is also exceptional in its method of treatment as compared with other treatises on the direct-current motor. This treatment consists in emphasizing the action and control of the motors rather than their design. Heretofore, writers in dealing with the electric motor have not given to the matter of control the attention which it appears to deserve. Sometimes one or two methods are set forth practically, but many of the important ones are merely referred to or omitted altogether. Another fault characteristic of writing on this subject is the employment of imaginary machines as examples. The armature and field circuit resistances are assumed, the change of resistance by temperature rise probably overlooked, and the voltage drop occurring at the brush contacts is included in the armature resistance, notwithstanding that it does not vary with the current. In the present series of articles, every factor entering into the action of motors is taken account of and given its due weight, and all examples and the conclusions based upon them are real and with relation to the standard machines of to-day. The first article deals with general principles of the direct-current motor, and in succeeding articles the various types of motors and methods of control will be taken up and thoroughly considered in detail.

THE BERLIN CENTRAL STATION.

In the Digest will be found an abstract from the *Elektrotechnische Zeitschrift* of a very complete and instructive account of the station, or rather group of stations, supplying Berlin with electrical energy. As in the case of every great city, the electric supply service of Berlin has been an evolution, proceeding somewhat timidly and slowly at first, and then with splendid rapidity. At the start the distribution was over the usual three-wire network at 2 x 110 volts, and the result was, as in most large cities, a futile reduplication of stations in

the vain endeavor to keep up with the game. In various places different temporary expedients were adopted to extend the radius of distribution. Paris went to a five-wire system, most American stations ran up their feeder losses to amounts which they would now hardly care to confess, and Berlin built more stations. Eventually everybody had to step up and take his medicine, laying aside the ancient prejudice against alternating current and adopting polyphase distribution from large and economical generating plants and using the output in the form best fitting existing conditions. In Berlin the inner city is supplied with direct current as before, while the outlying districts are supplied with a three-phase, 3 x 220-volt service, with all primary, and most secondary, mains underground. The transforming stations are mostly in little kiosks where the apparatus is very accessible.

The evolution of the system is as yet far less complete than in Chicago, for instance, which has not far from the same population. The American city has worked out more fully the centralization of the generating plant and the organization of the service. Berlin still has six stations in which energy is generated, besides eight more in which there is transformation from alternating to direct current. All save the two great generating stations, Oberspree and Moabit, and a single smaller station, have storage batteries. Yet the Berlin plant has taken the step at which several of the big American cities have hesitated and put in its three-phase equipment at 50 cycles. Both motor-generators and rotary converters are used at this frequency, the latter being generally provided with an auxiliary regulating armature, a feature substantially unknown in American practice. The transformers are generally of the combined three-phase type, which, while long standard in Europe, we on this side of the water are just beginning to make acquaintance with. The equipment of the Berlin plant is still far from reaching the unity of apparatus common here; the machinery is more diversified and the progress towards consistent development has been less rapid than here. In the large features the American stations are certainly ahead; in some of the technical details they are as certainly behind, owing less to lack of enterprise than to over-hasty standardization. In point of efficiency, the German apparatus compares very favorably with that of the best makers here. A three-phase transformer is mentioned, for example, which although of but 1200 kilo-volt-ampere output, has a full-load efficiency of 98.7 per cent.

Some interesting details of the steam practice are given, which should furnish food for thought. As in this country, the steam turbine is making rapid progress in Germany and has been introduced in all the recent work in Berlin. Not only is its importance in saving space fully recognized, but it seems to have been well established that it gives materially higher economy. It also appears, however, that the reciprocating engines in the Berlin stations beat out not only all their class here, but the vast majority of American turbines of anything like the same output. A 3000-hp-reciprocating-engine set, for example, giving the kw-hour on 14¾ lbs. of steam should make the American engineer sit up and take notice. This performance is a little better than that of a 7500-kw-turbine set recently tested in one of the largest central stations here, and considerably better than the figures reached by the usual American turbine of similar output. The Berlin turbines, however, have this engine performance badly beaten, since for a 3000-kw unit they have reached the low figure of 13.2 lbs. of steam per kw-hour, and on occasion they have knocked 10 per cent off even this result. This beats the best recorded figure for American turbines even of three times the output. To do our turbine builders justice, the extraordinary German results are due mainly to the use of liberal superheating. Most American engineers are mere tyros at this game, plodding along 10 years behind the times, putting up long-winded excuses instead of superheaters. When they once pluck up courage and get into the business with the energy they have displayed in some other things, the records will get a shaking up. But to-day, afloat and ashore, they are lagging, as witness one of the big foreign freighters plodding on her daily course with a consumption of less than one pound of coal per hp-hour, thanks to superheat and high expansions. Perhaps a few years of such teaching by example will produce results where precepts have failed.

Direct-Current Arc Lamp for Testing Purposes.

It is well known that the direct-current arc lamp may be made to produce high-frequency alternating currents, by applying to the arc a branch or shunt circuit containing a suitable condenser and inductance coil in series, the phenomenon having first been recorded by Prof. Elihu Thomson. The arc and the branch circuit tend to form a closed local alternating-current circuit. The arc is traversed by the exciting direct current and also by a locally superposed alternating current. The resultant current through the arc is, therefore, pulsating. The rapid pulsations of current give rise to corresponding pulsations of vapor pressure, that set up sound waves in the surrounding air, and the arc tends to sing, or emit a musical note, of a pitch corresponding to the frequency of the alternating current. The properties of the singing arc have been investigated by Duddell. A rough mechanical analogue of the singing arc is presented by various prenomena of friction. If we rub a finger over the moistened surface of a massive solid, such as a wooden table, we do not readily elicit therefrom a musical note. The frictional pressure along the table is steady. If, however, we similarly rub the finger over the surface edge of a small body which is adapted to vibrate, such as a small bell, a glass tumbler, or a glass bowl, we may readily throw the body into vibration, and make it sing. Owing to the elasticity of the body, the frictional pressure along its edge exerted by the finger, is not steady, but becomes vibratory in conformity with the natural rate of vibration of the tumbler. In the same way, the ordinary direct-current arc lamp may be regarded as a simple frictional resistance which does not present any elasticity, or tendency to oscillate, under the stimulus of a steady current; but when shunted by an elastic circuit containing a condenser and induction coil, the stimulus of a direct current may throw the arc and elastic circuit into vibration. The frequency of the alternating current set up in the elastic local circuit of the arc will depend upon the natural frequency of that circuit as determined by the magnitudes of the capacity and inductance jointly, with a correction for the resistance of the circuit. If the capacity and inductance are both small, the frequency of oscillation will be relatively high, and the arc will tend to sing a high note. If the capacity and inductance, or either of them, is enlarged, the frequency of oscillation will be lowered.

The oscillating arc in air has been used in Germany for producing oscillations in a wireless telegraph air-wire at the sending station, and Poulsen has applied the oscillating arc in hydrogen to the same purpose. An article by Mr. C. Heinke, of Munich, as noted in our Digest, appears in a recent number of the *Elektrotechnische Zeitschrift* on the application of the singing arc to alternating-current measurement. The article shows that an ordinary small direct-current arc, taking about 2 amperes with 50 volts at carbons or condensing, say, 100 watts from a direct-current circuit, may excite an alternating current of about 5 amperes at an alternating e. m. f. of some 35 volts or say 175 volt-amperes of apparent power, the frequency being perhaps from 30,000 to 50,000 cycles per second. These frequencies are above the limit of audibility, so that the arc does not emit under these conditions any audible note. If an attempt is made to take power from the arc, the elasticity of the shunt circuit is destroyed after a certain amount of load is included, so that only a relatively small amount of alternating-current power can be taken from the oscillating circuit, say 30 watts in the case of a single little arc lamp. This, however, is sufficient for many testing purposes, where the alternating-current power required is trivial. The interesting fact is thus emphasized, and illustrated in a variety of experimental ways, that an ordinary direct-current arc lamp may be looked upon as a possible laboratory generator of sinusoidal alternating currents. Whereas, an ordinary alternating-current generator has a fixed frequency, the arc-lamp generator can be made to give any frequency from a few hundred up to hundreds of thousands of cycles per second, by adjusting the capacity and inductance in its circuit. As against the advantage of this flexibility of control in frequency there is, of course, some offsetting disadvantage in unsteadiness of frequency if any change be made in the alternating-current circuit.

SMALL ISOLATED PLANTS.

It is well understood in the present state of the art that electric lighting from isolated plants is being hard pushed by the central stations. The day of special rates for the purpose of knocking out isolated plants is perhaps waning, yet the secret rebate or its equivalent in case central station service is taken and the obnoxious dynamo removed from the basement is a well-known though none too respectable member of electrical society. Some day the public will get tired of paying the basic price to help central stations extinguish competition and there will be rigorous regulations established to prevent this unjust discrimination. But even so, the central station can profitably replace isolated plant service in a singularly large number of cases, considering the ease with which an isolated plant can be built and operated. Of course, the station has the advantage of generation on a very large scale, but to offset this it has a very heavy general and distribution expense and is usually trying to pay dividends on the capitalized depreciation of the last decade, so that in total cost of product its advantage is less than would at first seem probable.

The reports of operation of isolated plants are generally too imperfect to allow a fair judgment of the real cost to be made and the quality of the service is not taken into account, so that the actual competitive figures on cost are for the most part very uncertain. It seems, therefore, worth while to examine some of the common failings of isolated plants with a view to examining their causes and possibly the appropriate remedial agents.

In principle an isolated plant of moderate size, say a hundred kilowatts or so, should generate energy if the load factor be reasonably high at a figure that would make the central station man groan. It is not that the generating costs themselves are high in the latter's practice, but that the incidental and distribution expenses run to necessarily large figures. Yet we think that the reputed economy of the isolated plant is very often rendered illusory by bad load factor and a relatively very large cost of labor. Of late it has been the fashion for the gas companies in hustling for business to put out statements of a very roseate character concerning the cost of producing energy by gas engines. Now there is no manner of doubt that given steady load at a good load factor, a gas engine plant judged by the fuel bill alone, can deliver energy at a very low figure, say at the rate of a quarter of a cent per lamp-hour or some such figure. On the other hand, the usual attendance, repairs and depreciation account at the present time make so large an increase in the cost of output per kw-hour as to give a very sorry looking balance sheet in the majority of cases. And unless there is skilled attendance the regulation of the gas engine plant is likely to be shockingly bad. Even in the case of comparatively large steam driven isolated plants the service is frequently very bad, as we showed in several articles recently published. An engineer who looks after an electric plant incidentally generally delivers a merely casual voltage. When an isolated plant, say in a big hotel, rises to the dignity of a proper operating force and a large load it can give thoroughly first-class service and can and does make the central station hustle to cut under it in price.

The fact is that up to the present time no one seems to have made a specialty of fool-proof isolated plants. A generator of the kind that comes handy is coupled to any gas engine that the glib tongued agent unloads, a cheap switchboard is put in and the affair starts off. The possibility of a compact direct coupled engine set with really good automatic regulation, and the safety appliances that will enable it to run practically without more than casual attention, has not yet been realized. However, if one bears in mind the really wonderful work of gasoline engines in the "sealed bonnet" automobile competitions, and realizes that a stationary gas engine should do much better, it seems reasonable to suppose that a self-contained automatic lighting set is well within the range of possibility, not to say probability. Such apparatus could very well be produced up to fairly large capacities—large enough to replace steam-driven sets in all but the largest installations. Or supplied with gasoline it could be used without the least dependence on the gas companies, anywhere. To be really in competition with gas lighting and acetylene, the isolated electric plant must be reduced to some such simple terms. *Per se* electric light is far more desirable than any other illumination, but it is still too costly to compete with gas on anything like even terms save where cheap hydraulic power is available. Improvement must come through improved lamps and cheaper generation on a modest scale, or else by a reversal of policy and the cultivation of the

smaller consumers by the electrical supply companies. Tantalum and tungsten lamps and automatic lighting sets would form a combination able to put electric light in thousands of places where it is not now used. In the long run even the central stations would reap the benefit, since every electric lamp installed helps on the general demand.

Free Residence Wiring.

In the early days of electric lighting many central-station companies, in order to get the electric light introduced, did a large amount of free wiring for their customers. This practice rapidly disappeared, however, because it came to be generally recognized that electric wiring, like gas piping and plumbing, is an integral part of the house, and that it should therefore be paid for by the owner of the structure rather than by the company supplying the service. To some old-time central-station men who were glad enough to get rid of the electric wiring burden, the article elsewhere in this issue on the wiring of 1200 houses free at Pueblo, Col., may cause somewhat of a shock. It seemed like a rather radical proposition to the central-station men at the Colorado convention when Mr. J. F. Vail, of Pueblo, told what he had been doing. Further investigation of the conditions under which it was done shows that the method of getting business is not quite as heroic as it would seem at first thought. In fact, it probably cost less to get these residence customers in this way than if the company had spent several years soliciting them. In the meantime they are on the lines and paying the regular revenue. It is not every place that conditions are as favorable to a movement of this kind as at Pueblo. Its success depends on the presence of a large number of small houses which can be cheaply wired and which are occupied by tenants earning good wages who will spend money freely for electric light after once it is installed. In a community where the cost of wiring per house would be 8 or 10 times that under the peculiar conditions at Pueblo, and where the revenue per house would probably be no greater, the plan of course would not be successful. The plan is one which should work best in manufacturing and mining communities, and there are doubtless many places besides Pueblo where it is the cheapest way to get this fairly profitable class of business. This business is more profitable than that from large scattered residences, as it has a better load factor, and more revenue can be obtained from a given investment in transformers and lines. In fact, the load factor of this class of business is frequently better than of store lighting, which pays a lower rate.

Data on City Water Pumping.

The data given by Mr. H. P. Gunnison on the Grosse Pointe waterworks' electrically operated centrifugal pumps at the Michigan Electric Association convention, published elsewhere in this issue, are of considerable interest to companies which contemplate entering into pumping contracts with their city waterworks. The present instance represents about what can be done with centrifugal pumps of very good efficiency operating under the rather adverse condition of a suction lift of from 15 ft. to 20 ft. Such high suction lifts are not favorable for either the economy or best operation of the centrifugal pump, but, as shown by the Grosse Pointe experience, the economy and reliability are far better than those of the steam pumping station which such a plant usually supersedes. For ideal operating conditions centrifugal pumps should be so located as to be below the water level at starting. When this is done the necessity for attendance is reduced to a minimum and they can be operated with automatic starting appliances, as are many reciprocating waterworks pumps at the present time. Another interesting feature about the Grosse Pointe plant is the terms of the contract with the city, payment being based upon a certain amount per million gallons of water pumped. This is probably the most satisfactory form of contract to both parties, as city officials naturally prefer to contract for gallons of water delivered rather than kw-hours supplied to the pump motors. The information on cost of pumping with steam and electric pumps and on kw-hours per 1000 gallons given by Mr. Gunnison, while not laying any claims to extreme accuracy, nevertheless gives central-station companies figuring on city pumping contracts much data that may prove of value. The results show roughly that about 1 gal. per watt-hour can be counted on with 41 lbs. average water pressure and 16 ft. to 20 ft. of suction lift.

Unprogressive Gas Users.

Unquestionably, a gas mantle burner operating on cheap gas or gasoline can produce a large amount of light for little money if fuel expense only is considered. Nevertheless, gas and gasoline lighting are rarely found in the most progressive stores. When a central-station company's rates are right and service good, gas and gasoline competition should not be very serious in any town, provided the central-station company puts the matter before merchants in the proper light. The opinion of a successful merchant, quoted elsewhere in this issue in the "Sale of Current" department, expresses very concisely the opinion of a community generally as to the unprogressiveness and inferior standing of a merchant who persists in using gas or gasoline for lighting. Gas is recognized as out of date by the public generally, and the merchant who insists on using it for the sake of an apparent saving of a few cents is likely to fall in the public estimation the moment he does so unless the general policy and the illuminating engineering ability of the central-station company are so atrociously bad that the gas lighting seems good by comparison with the electric installations in the town. The best way of bringing home to a merchant the bad position in which he puts himself before his customers when adopting gas lighting is to call his attention to how absurd it would seem to think of the most successful merchants in the larger cities using gas for lighting. The unthinkable nature of such a proposition and the personal pride of the merchant in his business will do more to throw out gas and gasoline competition than anything else, provided, of course, as we said before, the electric service and rates are what they should be.

Increasing Revenue from Present Customers.

Some information of direct commercial value to central-station companies is contained in the account published elsewhere in this issue of the experience of the central-station company at Denver with a class of solicitors called service supervisors. It is the duty of these service supervisors to look after increasing the revenue from the company's present customers. They make no effort to get new customers. The

work so far at Denver has been confined to the residence districts. No central-station man worthy the name needs to be told that an increase of revenue from existing residence customers is one of the most profitable forms of increased business there is. It is the kind of business that shows up on the right side of the ledger at the end of the year, for it usually involves no additional construction cost and little, if any, increase in the maximum demand. The majority, however, before reading the Denver experience would probably much underestimate the amount of increased revenue which could be secured with a given amount of solicitation in this class of business. When a dollar spent in solicitation means an increased yearly revenue of from $2 to $3, and when the revenue from existing customers can, in a short time, be increased 28 per cent without any investment on the company's part other than that invested in solicitation, the proposition is worth looking into. Of course, Denver conditions are decidedly different from those which prevail in the majority of Eastern cities of the same size. The great majority of residences already use electric light. Growth of business in the residence district is therefore dependent on the natural growth of the city and the possibilities of increasing revenue from existing customers. As our readers well know, the Denver field has been very thoroughly worked by a large and efficient central-station commercial department for five years past. The recent changes in that company's soliciting organization which provide for a much larger percentage of soliciting effort to be devoted to increasing the revenue of old customers, is a natural outgrowth of the activities displayed in Denver. It is also an evidence that under Denver conditions the service supervisor is able to show greater results per dollar expended in his work than a man who is looking after all classes of business. The conclusion must not be reached, however, that in other cities where the field is much under-developed as compared with Denver, the time is yet ripe for devoting so large a proportion of the attention to existing customers. In the residence districts of the majority of cities there are so many residences which are on or near existing secondary lines and which could be connected at very small cost, that a great deal of attention should be paid to getting this class of customers. If a company has been at all wide-awake about its distribution system, nearly every residence in town is within reach of the service and every new residence customer connected, means an increase in the percentages of gross and net revenue earned on the investment.

THE LIGHTING OF A LARGE RETAIL STORE.

Illuminating engineers, as well as merchants, have been watching with much interest the past eighteen months the practical tests on a large scale of several modern competitive systems of store lighting which have been carried on in Chicago's largest retail dry goods establishment. The presentation of Mr. Frederick J. Pearson's paper on the lighting of that store before the recent meeting of the Chicago section of the Illuminating Engineering Society was, therefore, an affair of more than local interest. Probably never before in the history of illumination have comparative tests been carried out on such a large scale as in this case. Large areas of a large store were given over to trial installations, and fortunately these installations were so located that direct visual comparisons could be made by any observer. Such visual tests were supplemented by engineering calculations and by measurements of the illumination in foot-candles at certain points on the store counters. Mr. Pearson is undoubtedly right when he lays emphasis on the fact that a direct comparison by inspection made by any ordinary person and by the sales managers of the store is more to be considered than the results of measurements of illumination open to more or less error, although such tests were given due weight. While the tests of several competing modern highly efficient installations are of much interest, even more interest attaches to the striking difference between the old inefficient arrangement and the modern, well-designed installation. Those who have frequently visited the store during the progress of these tests know full well that the improvement in general appearance and good impression on the public is fully as marked as the improvement in efficiency shown by the engineer's figures. Roughly speaking, almost any of the well-designed modern systems tried in this store gave better illumination on the counters than the old system with one-half the power used by the latter, and this too with an immense improvement in the general appearance of the store. Could anything more strikingly illustrate the practical importance of good illuminating design? The difference in efficiency is by no means to be credited entirely to the better efficiency of the recent high-efficiency lamps. It is due fully as much to the fact that the new methods make use of a larger percentage of the total light given out from the lamps.

The old method of lighting was by chandeliers hung low with lamps in glassware which allowed the light to escape about equally in all directions, with the result that a large percentage never reached the counters. All of the well-designed modern systems tried consisted of units in which a large percentage of the useful light was directed toward the counters, thus securing high efficiency even though the units were placed high up near the ceiling where they were out of the line of vision. Thus, the new systems allowed the customer to look far across the store and see well-lighted goods rather than an array of blinding lamps on low chandeliers. Furthermore, the units placed high near the ceiling obviate the many annoying shadows from store fixtures and goods hung up for display that were present with the old system. As to the relative efficiency of the various modern installations tried, it was a very close battle, judging both from the figures given by Mr. Pearson and by the every-day observation of a number of illuminating engineers who have been watching the game. The final selection seems to have hinged on color, general impression created on sales managers and others and on the guarantees manufacturers were willing to make on cost of lamp maintenance covering a considerable period. As Mr. Pearson remarked during the discussion, such guarantees embodied in a contract looked very different from the off-hand figures given as to the probable life of lamps. Another interesting thing brought out during the discussion was that even though we are in the midst of great improvements in lamp efficiency, and a decision reached to-day may not be the decision which would be reached to-morrow in deciding upon the lamp use in a large installation, it was, nevertheless, entirely safe in this case to change the entire system of illumination without hesitation, for the reason that enough operating expense could be saved in a short time with the new, as compared with the old installation, to pay for the change, even though the new system were thrown out for something more efficient within a relatively short time.

Economic Changes in a City Charter.

The Merchants' Association of New York, through its board of directors has made a number of suggestions to the Charter Revision Commission as to desirable changes in the city charter. One of the most important of these is that a special commission be appointed to analyze the functions of every branch of the city government, and formulate a proper system of accounting and statistical record for each, in order that the annual outlays of each may be effectively scrutinized and the annual requisitions presented in such form that the Board of Estimate and Apportionment can act thereon with full knowledge. The association contends that at present the city budget is largely voted upon requisitions in bulk without adequate exhibits of expenditures in detail, and without the statistical records necessary to intelligent judgment upon the proposed outlays. In consequence many of the appropriations for various purposes are largely in excess of the amounts actually needed, and cover great waste.

The association believes that such a commission should be composed principally of business men with large experience in directing the accounting, reporting and auditing of large business enterprises with a view to economical administration by means of concrete and readily understandable reports in such form as to fully exhibit all transactions; and that the comptroller should be ex-officio a member. The commission should have at its command an adequate force of expert accountants, engineers and clerical assistants.

To do away with present conflicts of jurisdiction and concentrate responsibility, the association recommends that the borough presidents be divested of the control of highways, sewers and incumbrances; that the Department of Street Cleaning be abolished, and that the Department of Water Supply, Gas and Electricity be divested of the control of gas and electricity, of lighting of the streets, and of the restoration of pavements removed for the laying of water pipes. It further recommends the creation of a new Department of Street Control, to have sole jurisdiction throughout the city, (a) of regulating and grading highways; (b) of construction and maintenance of pavements and sidewalks; (c) of openings in streets, pavements or sidewalks and the restoration of the pavement or sidewalk disturbed by such openings, including pavement removed by the Department of Water Supply; (d) of cleaning the streets, and disposal of street wastes; (e) of building materials and other incumbrances in the streets; (f) of the operations in the streets of gas, electric lighting, telephone, steam and other public service corporations; (g) of lighting the streets; (h) of the construction and maintenance of sewers; (i) of the construction and control of vaults under sidewalks, openings into vaults, protection of areas, hoistways, etc.; (j) of showcases, awnings, obstructions on sidewalks, structures within the stoop lines, and similar street encumbrances.

It is suggested that when a new pavement is to be laid or a pavement opened for any large constructive work, notice be sent to all public service corporations to the effect that the pavement will be opened at a specified time and that such underground structures as they desire to make must be made forthwith; and that no public service corporation be permitted to make any opening for the installation of mains in such street for a period of one year thereafter. In the case of residence streets it might be desirable to require that when water and gas pipes and electric wires are laid in the street, service connection for each lot be extended from the mains to the curb line, in order that when connection with any residence is thereafter desired, such connection may be made without breaking the pavement. An official map of underground structures in the streets is recommended, the absence of such map causing great delay in the construction of underground works, the removal of needlessly great expanses of pavement, thereby resulting in the unduly long continuance of openings in the pavement.

Association of Iron and Steel Electrical Engineers.

The recent meeting in Pittsburg (Oct. 9 and 10) of the Association of Iron and Steel Electrical Engineers was unusually successful for the first meeting of a body so recently organized. The object of the association is the advancement of the application of electrical machinery in the iron and steel industries, and membership is limited to electrical engineers and electrical superintendents in that industry and to those who have done original work of recognized value to the industry. Representatives were present at the meeting from the leading iron and steel companies of the United States. At an election held during the meeting, the following officers were elected:

President, Mr. James Farrington, superintendent of the electrical department of LaBelle Iron Works, Steubenville, Ohio; first vice-president, Mr. J. C. Reed, electrical engineer of Pennsylvania Steel Company, Steelton, Pa.; second vice-president, Mr. G. W. Sturgess, electrical superintendent of the Lackawanna Steel Company, Buffalo, N. Y.; secretary, Mr. G. H. Winslow, electrical engineer of the National Tube Company, Pittsburg, Pa.; treasurer, E. W. Yearsley, electrical engineer of Midvale Steel Company, Philadelphia, Pa.

At the meeting the first day, papers were read by two members, as follows: "Auxiliary Control and Automatic Acceleration of Electrical Motors," by Mr. E. W. Yearsley; "Heavy Duty Load Starting Direct-Current Motors in Steel Plants," by George W. Richardson.

Contributions to the proceedings in the form of papers or informal talks were made by the following representatives of manufacturing companies: Messrs. B. A. Behrend, Gano S. Dunn, D. B. Rushmore, D. S. Kendall, R. B. Treat, E. Heitmann, Jr., F. R. Fortune, R. D. Wright, C. T. Henderson, R. P. Jackson, Paul M. Lincoln and H. D. James.

On Tuesday evening, the Crocker-Wheeler Company gave a dinner to the members, at which there was a discussion of mill motors in continuation of Mr. Dunn's talk in the morning. On Wednesday evening the Allis-Chalmers Company gave a dinner at the Duquesne Club to the association, at which also there was a continuation of the discussion of the day. At the end of the session of Wednesday morning, the members visited, by invitation, the Westinghouse works at East Pittsburg, and after a luncheon given there by the Westinghouse Company, they made a tour of inspection of the various shops.

Electrical Purification of Water.

Prof. Leon Gerard, the eminent Belgian scientist, past president of the National Society of Electrical Engineers of Belgium, gave a lecture before the Western Society of Engineers at Chicago, Oct. 25, on "The Use of Electricity in the Purification of Water." The lecturer dealt entirely with the electrical production of ozone and the effects of treating water with ozone to burn out the organic matter. By way of introduction he reviewed briefly the three methods of treating water to destroy bacteria. The chemical method consists of adding free agents which may, to a certain extent, poison the water while destroying the organic matter. The mechanical method, or filtration, attempts to strain out the bacteria. The electrical method, or treatment of the water with ozone produced electrically, burns, or oxidizes, the bacteria without producing any injurious changes in the water. He described apparatus for producing ozone devised by various investigators, and also, after the lecture, described the apparatus devised by himself by special request. He stated that with this apparatus 50 watt-hours would produce enough ozone to purify, entirely and surely, 1000 gallons of ordinary water.

In the discussion, Mr. L. A. Ferguson, vice-president of the Commonwealth Edison Company, Chicago, stated that such processes are of great interest to central-station companies looking for work which would utilize generating capacity during

hours of light load, and he inquired into the commercial feasibility of such purification systems. Prof. Gerard showed that the cost of treating water even for such a large per capita consumption as exists in Chicago would be so small a proportion of the total cost of supply that it would be entirely feasible, being probably not over two per cent of the present cost. Mr. Ferguson also asked as to the feasibility of purification apparatus in small sizes for schools, large hotels and apartment buildings. Prof. Gerard said that apparatus as low as 10 watts capacity is feasible from an engineering standpoint, but that the cost of such a small apparatus is too great. The working voltage of the apparatus is from 9000 to 13,000. About 11,000 volts is best. A frequency of 60 cycles is admirably adapted to the work.

The Osmin Tungsten Lamp in Austria.

Below are given the results of some official tests made in Austria of osmin tungsten lamps, manufactured by the Westinghouse Metallfaden Gluhlampenfabrik, of Vienna. The factory occupied by this company is the one in which Dr. Auer von Welsbach made his experiments some years ago which resulted in the osmin incandescent lamp; and it was here that Dr. Anton Lederer, one of the former assistants of Dr. Welsbach, developed the osmin tungsten filament lamp. Dr. Lederer started as far back as 1902 to experiment with tungsten filaments, the original osmium process having clearly indicated the way to the use of similar metals for lamp filaments. It was from these works that the German Welsbach Company

WESTINGHOUSE LAMP WORKS, VIENNA.

(Deutsche Gasgluhlicht Gesellschaft) originally received information on which it started the manufacture of tungsten lamps in Germany. The factory passed under the control of the Westinghouse Company July 1, 1906, together with all of the rights for the manufacture there of osmin lamps.

The Technical Commercial Museum of Vienna (Technologisches Gewerbe-Museum) has tested a number of osmin lamps with the result given below.

Lamp No.	Initial Watts per Hefner.	Watts per Hefner After 1776 Hours.
996	1.02	1.08
1000	1.06	1.08
1002	1.03	1.09
1004	1.01	1.09
1007	1.03	1.10

A hefner is about 0.9 candle-power. Of the six lamps tested, one burned out at the end of 1776 hours, which ended the test.

The osmin lamp has been tested by the Vienna Municipal Central Station for variation of candle-power with life. The falling off in candle-power at the end of 2239 hours was found to be 16 per cent, the watts during the same period increasing from 1.10 to 1.28 per hefner. The initial candle-power of 31 hefners increased to 31.5 hefners at the end of 189 hours; at 600 hours it became 29.3 hefners; 28.6 hefners at the end of 1000 hours, and 26.6 hefners at the end of 2239 hours.

At the present time osmin lamps are made at the Vienna factory as follows: 100-130 volts, 25, 30, 40, 50 and 100 hefners; 150-160 volts, 40, 50, 60 and 100 hefners; 200-220 volts, 50 and 100 hefners; 50-60 volts, 20, 30 and 40 hefners. Storage battery lamps are also made for the following voltages: 1.8-2.0, 3.5-4, 5.4-6, 7.2-8, 10, 12, 14, 16, 20 and 24, and in hefners ranging from 0.5-1.6 for the smaller voltages to 12-24 for 24 volts.

Electrical Advances in Mexico.

The electrical development of Mexico is attracting world-wide attention. The fact that the hydraulic plant of the Mexican Light & Power Company, at Necaxa is developing more than 50,000 horse-power gives some idea of the magnitude of electrical enterprises in this country. The Mexican Light & Power Company is a Canadian concern which has invested more than $40,000,000 gold in the installation of electrical plants in Mexico. The energy which is generated at its Necaxa plant is transmitted to Mexico City, Puebla and El Oro, where it is used for lamps and to operate street railway systems and various industrial plants. The system has been fully described in the pages of the ELECTRICAL WORLD. The German government sent a commission of electrical experts to Mexico to inspect and investigate the great electrical power plants of the country. This German commission is headed by Geheimrat Gustav Wittfeld. It consists of six other members. They have been in Mexico for some time and much of their time has been spent at Necaxa. The original concession which the Mexican government granted to the Mexican Light & Power Company called for the development of 30,000 horse-power within 10 years. This was in the spring of 1903. Now, in a little less than one-half the time, 20,000 horse-power more than the required amount of 30,000 horse-power has been developed, while with the improvements at the plant which have been under way for some time, this capacity will be increased to about 110,000 horse-power. The German commission will also inspect the El Dura hydro-electric plant of the Guanajuato Light & Power Company, which furnishes many of the mines of the Guanajuato district with energy for motors as well as lamps for the cities of Guanajuato, Irapuato and other places of that region. A number of electrical men from Germany are accompanying the government commission on their trip.

The improvements and enlargements which the Compania Electrica é Irrigadora is making to its hydro-electric plants and transmission system in the state of Hidalgo will have cost more than $3,250,000 when completed. Plans have been adopted for the erection of a new hydro-electric plant at Tetepango. Bids have been received from manufacturers of electrical machinery in the United States and Europe for electrical and turbine equipment for the proposed plant. It will have a capacity of 6000 horse-power. The new Tetepango plant will cost more than $2,500,000. The company is also installing a new plant at La Canada at a cost of about $750,000. This plant will have a capacity of 1250 horse-power. The two plants which the company already has in operation at Juando and Elba have a total of 7000 horse-power. The water for the turbines of La Canada plant will be piped through pipes 90 ins. in diameter for a distance of nearly 1000 ft. It is said that these pipes are the largest in diameter ever attempted. The contract for them was awarded to an American manufacturer in open competition with Europeans. La Canada plant will supply the great cement works and other industrial enterprises of Dublan with energy.

Manuel Cuesta Gallardo, of Guadalajara will install a hydro-electric plant at Puente de Tololotlan, on the Santiago River, about 15 miles from Guadalajara. It will have an initial capacity of 2050 horse-power. He has entered into a conditional contract to supply the mining districts of Etzatlan and Hostotipaquillo, state of Jalisco, with electric power. He will build transmission lines into those districts and expects to have the plant completed and in operation within 18 months. A proposition is also pending from the Compania de Tranvias, Luz y Fuerza, of Guadalajara to furnish the mines of the Etzatlan

and Hostotipaquillo districts with electric power. This company estimated that a double transmission line, with the necessary sub-stations and branch lines would cost $960,000, and a single transmission line $650,000. The mining interests were asked to advance one-half the cost of the proposed transmission line. The prices quoted were $120 per horse-power a year in the Etzatlan district and $135 in the Hostotipaquillo district. Mr. Gallardo has asked an advance of $200 per horse-power contracted for or a total of $410,000, the amount to be paid back in power. He promises to invest not less than $1,000,000 in the project.

A syndicate of men from Montreal, Canada, which owns a concession to install a hydro-electric plant on the Conchos River, in the state of Chihuahua, has contracted with mine owners of the Parral district to supply them with 20,000 horse-power. It is stated that the syndicate has planned to build transmission lines to the cities of Parral, Chihuahua, Santa Rosalina and Jiminez. The proposed plant will have a capacity of 30,000 horse-power. The plans for the plant are now being drawn and its construction will soon be begun, according to recent advices.

A hydro-electric plant of 1000 horse-power is to be installed on the Ameca River in the San Sebastian district, state of Jalisco, by the Natividad Mines & Reduction Company. The plans of the company call for the driving of a tunnel 700 ft. long, and the construction of a canal one mile in length. These works will give the water a fall of more than 100 ft. It will furnish power for other mines of the district as well as its own.

Edward J. Cummings, a capitalist of Guanajuato and associates, are preparing to install a large hydro-electric plant on the Quiotepec River near Tomellin, state of Oaxaca. The plant will have a capacity of 48,000 horse-power. The electrical energy will be transmitted to Puebla, a distance of 130 miles; Oaxaca, a distance of 70 miles, and Taviche, a distance of 100 miles. Energy will also be supplied the intermediate towns of Cuicatlan, Etla, Huitzo, Ocotlan and other smaller places. It is expected that this cheap power will greatly stimulate the mining industry of a number of districts of the state of Oaxaca.

Narcotic Effects of Electricity.

Mr. Nikola Tesla in a recent communication to the New York *Times* says: "I have read with interest the reports referring to Prof. Leduc's discovery of causing sleep by electric means. While it is possible that he has made a distinct advance there is no novelty in the effect itself. The narcotic influence of certain periodic currents was long ago discovered by me and has been pointed out in some of my technical publications, among which I may mention a paper on 'High Frequency Oscillators for Electro Therapeutic and Other Purposes,' read before the American Electro-Therapeutic Association, Sept. 13, 1898. I have also shown that human tissues offer little resistance to the electric flow and suggested an absolutely painless method of electrocution by passing the currents through the brain. It is very likely that Prof. Leduc has taken advantage of the same general principles, though he applies the currents in a different manner.

"In one respect, however, my observations are at variance with those reported. From the special dispatch in the *Times* of the 13th inst. it would appear that sleep is induced the moment the currents are turned on, and that awakening follows as soon as the electrodes are withdrawn. It is, of course, impossible to tell how strong a current was employed, but the resistance of the head might have been, perhaps, 3000 ohms, so that at 30 volts the current could have been only about 1/100 of an ampere. Now, I have passed a current at least 5000 times stronger through my head and did not lose consciousness, but I invariably fell into a lethargic sleep some time after.

"I have always been convinced that electric anæsthesia will become practical, but the application of currents to the brain is so delicate and dangerous an operation that the new method will require long and careful experimentation before it can be used with certitude."

The Use of the Name "Edison" as an Advertisement Restrained.

It may not be generally known that Thomas A. Edison is the originator of a formula for the alleviation of physical pain. It seems that early in his career he compounded a medicinal preparation intended to relieve neuralgic pains by external application. It was first made for the personal use of Mr. Edison and his assistants, and not for sale. In the year 1879, a Mr. Lewis and a Mr. Jacobs went to his laboratory in Menlo Park to examine his inventions. While there, Mr. Edison happened to mention the fact that he had been a sufferer from facial neuralgia, and that he had made a preparation which he had called "Polyform," and which he had found to be a good pain killer. Lewis and Jacobs were so impressed with its merits that they asked him to sell it. He finally agreed to sell for $5,000. The arrangement was that he would apply for a patent and execute an assignment. The patent does not appear to have been issued, but a written assignment of his right to it and to the preparation was made on Sept. 2, 1879. Several different companies were organized to exploit the preparation and each, in turn, failed. Finally the Edison Polyform Manufacturing Company, the present defendant, was incorporated and took up the business. On each bottle was a picture of Mr. Edison and the following words: "Edison's Polyform. I certify that this preparation is compounded according to the formula devised and used by myself. Thomas A. Edison."

Recently an action was brought for the purpose of restraining the use of the name and picture of Mr. Edison in connection with the sale of the medicine. Mr. Edison testified that he never authorized the use of his picture and that he never made nor authorized this certificate. An injunction was granted restraining the defendant from holding out, either in the name of the company, or by pictorial representation, that Mr. Edison was in any way connected with the business. The decision is based upon the theory that a man has a "property" right in his features. This right seems to have originated in an article appearing in the *Harvard Law Review* in 1890, and has come to be known as the right of privacy. Prior to that time, if a man's picture was made use of by commercial pirates for the purpose of advertising their goods, he had no cause of action for damages. Several States, however, have since held that the unauthorized use of one's picture as an advertisement is a proper ground for legal damages. The well-known case of the Rochester Folding Box Company has a similarity to the present action. There the New York Court of Appeals held that a young woman, whose likeness had been printed upon posters advertising flour, was not entitled to damages. The decision was made by a bare majority of the court, former Judge Alton B. Parker writing the opinion, and it has been disapproved of in other jurisdictions. The matter is now controlled by statute in New York State, and the use of the picture of any living person for advertising purposes without the consent of that person is prohibited.

Electrochemistry in France.

Some details as to recent electrochemical advances in France are given by Mr. W. H. Hunt, U. S. consul at St. Etienne. With regard to the electrolytic refining of copper he says that there are several plants in France, and notably at Eguilles, near Sorgues, in Vaucluse, belonging to the Société de Cuivre de France, producing 2 tons a day; Givet, in Ardennes, with a production of 7 tons daily. There are also several minor factories scattered through the territory. All these factories produce copper in a very pure state, but it has to be always melted beforehand, on account of its physical conditions. At Dives, in Calvados, however, this operation is rendered unnecessary by the Elmore process, producing directly plates and tubes of copper by electrolysis, 12 tons daily.

The decomposing of water into hydrogen and oxygen is exploited by the following concerns: Manufactory of St. Vrain, near Ballancourt, employs the Hazard-Flamand process, and produces 200 cubic meters of hydrogen and 100 cubic meters of oxygen per day. La Société Oxydrique Française utilizes in its factories at St. André, near Lille, and Villeurbanne, near Lyon, the Garuti process, in which the cathodic and anodic compartments are separated by an iron partition pierced with a multitude of small holes. The daily production of these works is about 400 cubic meters of hydrogen and 200 cubic meters of oxygen.

The Electro Chemical Company furnishes hydride of lime (CaH), which gives off hydrogen in contact with water. This body, which sells at present at $1.93 per kilo (2.2 pounds), is commercially known under the name of "hydrolith." In the manufacture of soda by the electric process, the Volta Company, whose works are situated near Moutiers, utilizes the Outhenin-Chalandre process, and turns out 800 tons of soda and 2000 tons of chloride of lime per year. About 4000 tons of caustic soda manufactured annually by this method in France. Chlorate of potash is manufactured at St. Michel de Maurienne by the Gall process, and at Chedde, near Chamonix, by the Corbin and Lederlin method. The total production is about 7000 tons annually.

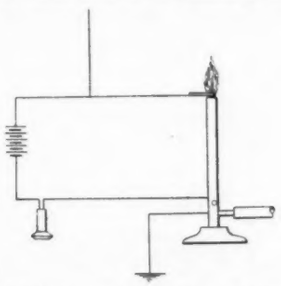
Aluminum is produced principally by three companies, that of Chemical Products, of Alais and the Camargue; at Calypso and St. Felix, near St. Jean de Maurienne; the French Electro-Metallurgic Company, at St. Michel and Chedde, near Chamonix. The total annual production is estimated at 6000 tons.

Carbide of calcium is already manufactured on a very large scale in France. It furnishes not only acetylene gas, but also cyanide of calcium as a fertilizer and as an agent for producing ammonia. Numerous companies employ electricity in the production of ozone, used in the preparation of certain organic products—vanaline, heliotropine, essence of hawthorn, etc. The electro-chemical industry has developed considerably within the last few years in France, and the amount of horsepower used is estimated at 100,000.

Wireless Telegraph Receiver.

Three patents recently issued to Dr. Lee de Forest disclose means for detecting aerial electric oscillations by the aid of a telephone. The wireless telegraph signals are received by causing the electric oscillations developed in a wireless telegraph receiving system to vary the conductivity of a gas maintained in a condition of intense molecular and ionic activity, and having associated and conducting ions.

One of the arrangements used by the inventor is illustrated herewith. The gas flame serves to maintain the medium separating the electrodes in the proper ionic activity. The electrode which is placed in the flame, is kept at a high temperature relative to the lip of the burner. Thus there is formed a local receiving circuit possessing a certain asymmetric electrical conductivity, whereby the current from the battery from the relatively cool burner to the more highly heated electrode. The influence of the electric oscillations reaching the antenna produces current variations in the local battery circuit and results in a signal in the telephone.



DE FOREST OSCILLATION DETECTOR.

Reorganized Extension Courses in Mechanical Engineering at Brooklyn Polytechnic.

The Polytechnic Institute of Brooklyn starting this year with the reorganized department of Mechanical Engineering in charge of Prof. William D. Ennis, is offering enlarged courses of extension work through its evening classes. These classes began with purely lecture courses about three years ago, and have developed into valuable adjuncts to the regular college work. They offer to the student employed during the day opportunities for study or review of elementary and advanced mathematics, besides practical courses on engineering subjects.

During the past summer the mechanical laboratories of the institute have been greatly enlarged and large expenditures made for new equipment, which now includes two steam engines with high pressure boiler, one gas engine, one gasoline engine, one 100,000-lb. testing machine, one small testing machine, pumps, meters, etc., besides the usual small equipment for field and laboratory testing. Laboratory courses are offered to evening students, involving the use of portions of this apparatus, and the training of the student in the precise measurements of engineering. A thorough course in machine design is also to be given under the direction of Prof. F. De R. Furman; this will be open to men who have completed the equivalent of one year's work in mechanical drawing, and is intended to fit such men for positions as detail draughtsmen. This course, in common with others offered, will be practical in its nature rather than mathematical. It is given on Fridays at 7.30 p. m.

The courses in heating and ventilating, by Prof. Taggart, given on the same day and hour, are planned to train men in the practical design of the commercial forms of direct and indirect heating systems.

On Wednesdays at 7.30 p. m. there is to be given a thorough course in mill engineering by Prof. Ennis. This will cover the problems met with in the arrangement of buildings, tracks and yards for large industrial works and especial discussion of the various elements entering into their engineering equipment. Attention is to be given particularly to the practical design of such features as crane installations, automatic sprinkler equipment, apparatus for generating and utilizing compressed air and hydraulic operative machines. The general principles covering the economical design of mill buildings will be discussed and exemplified, and the broad relations of engineering equipment to factory organization will be analyzed.

The major course of the series will be that on power plant design, given by Prof. Ennis, on Thursday evenings. This will start with a consideration of the power house as a manufacturing plant, its location with regard to the raw material and the market, the choice of site and standard types of buildings. The various items of equipment will then be discussed, their performance analyzed and their relations to the general problems of design investigated. The object of the course is to fit engineers for actual practice in the design and construction of steam or gas power generating plants. The mathematical knowledge required for admission is elementary only, the subject being one that permits of thorough treatment without an extended use of higher algebra or calculus.

The evening work at the Polytechnic Institute is largely pursued by men who are candidates for a degree. A certain amount of credit is allowed, based upon the courses taken during the evening, and the student has the encouragement of working toward the same definite end as the usual day student.

Self-Excited Alternator.

Three patents, issued Oct. 22, to Mr. M. Latour, of France, are interesting at this time, particularly on account of the date of application, July 9, 1901. The patents reveal an induction motor with a commutator on the rotary secondary used as a self-exciting asynchronous generator. The scheme employed

seems to differ from that with which the name of Heyland is frequently connected in that no resistance is connected between the commutator segments. One of the patents deals with a self-exciting alternating-current generator, consisting of an armature having a distributed winding and a many-part commutator, and a distributed field winding supplied with polyphase current. The other two patents are limited to the use of this machine as a shunt-wound generator and as a compound-wound generator, respectively.

George Westinghouse.

The New York *Times*, in speaking of the recent financial storm, and its results, says: For Mr. Westinghouse himself, the utmost sympathy will everywhere be felt. The regret will be general and sincere that he should suffer even temporary embarrassment. He has done so much for the splendid industrial evolution of the country, his enterprises have been so varied and so important, he has carried the name and the fame of American invention and development in the application of novel scientific principles over such wide areas and everywhere has won for his nation such admiration, confidence and respect, that he presents himself, in a way, as an American institution in whom we have patriotic pride. The wish will be universal and the belief general that he will come through the difficulties he has encountered safely with his material and intellectual resources undiminished, and ready for new triumphs.

The *Boston Herald* says: This undaunted man will surely emerge triumphant from the predicament in which the financial disturbances culminating this week have placed him and several of the great industrial companies of which he is the illustrious and honored head. George Westinghouse is a man who knows no fear and always conquers. * * * * * * Any serious reverse to a man of this character and force would partake of the nature of a public calamity. But he will not permit the present difficulty to seriously retard him. He will go on. It may truly be said of him that he has long been a creator of wealth, a discoverer of opportunity, a powerful influence in the advance of the age. In all lands men will rejoice, for his sake as well as for their own, that his industrial organizations are solvent, and everywhere there is hope that he will be spared for many more years of superb achievement by which armies of labor benefit and the whole body of civilization is aided in its onward march.

Development of the Central Station Industry.

Below is given an interesting classification of the central stations of the country, made on the basis of McGraw's "Central Station Directory," issued by the Electrical World. The compilation has been made by the Co-operative Electrical Development Association. As will be seen no fewer than 5577 places are dealt with, but of these 1020 are supplied from other points, leaving 4557 as the apparent number of communities; but this would include duplications where more than one central station exists in any given place. Thus it will be observed that one central station is returned in a city of 1,000,000 population and over as not giving night service. This would be both improbable and impossible, but for the fact that the city in question happens to be Chicago, which, of course, whatever minor plants it may have, enjoys the splendid service of the Commonwealth Edison system.

With regard to the subsidiary table showing a total of 1020 towns, these are, as stated, included in the larger table, but are those listed in the Directory as being lighted by companies or plants in other towns. For instance, the Houghton County Electric Light Company lights some 15 or 20 towns around Houghton, Mich., and this "territorial" drift of central station work becomes more pronounced each year, with the consolidation of enterprises and the extension of high-voltage circuits. The issue of the Directory used is that of March, 1907. We are indebted Mr. J. Robert Crouse for the data.

CLASSIFICATION OF CENTRAL STATIONS BY STATES

PURELY ELECTRIC,—GAS AND ELECTRIC,—ELECTRIC AND RAILWAY,—GAS, ELECTRIC AND RAILWAY,—MUNICIPAL,—24 HR. SERVICE AND NIGHT SERVICE.

1	2			3			4			5			6			7			8			9
POPULATION OF CITIES.	CENTRAL STATIONS PURELY ELECTRIC			CENTRAL STATIONS ELECTRIC AND GAS CORPORATIONS.			CENTRAL STATIONS ELECTRIC & RAILWAY CORPORATIONS.			CENTRAL STATIONS ELECTRIC, GAS & RAILWAY.			MUNICIPAL ELECTRIC PLANTS.			SUMMARY OF 2, 3, 4 & 5.			SUMMARY OF 2, 3, 4, 5 & 6.			POPULATION OF CITIES.
	(A) Night Service only.	(B) 24 Hour Service.	Total of A & B.	(A) Night Service only.	(B) 24 Hour Service.	Total of A & B.	(A) Night Service only.	(B) 24 Hour Service.	Total of A & B.	(A) Night Service only.	(B) 24 Hour Service.	Total of A & B.	(A) Night Service only.	(B) 24 Hour Service.	Total of A & B.	(A) Night Service only.	(B) 24 Hour Service.	Total of A & B.	(A) Night Service only.	(B) 24 Hour Service.	Total of A & B.	
1,000 & under 5,000	721	432	1,153	7	67	74	2	42	44		13	13	164	18	182	730	554	1,284	894	572	1,466	1,000 & under. 5,000
1,000 to 5,000	1,101	813	1,914	55	95	150	1	75	76	1	17	18	601	132	733	1,158	1,000	2,158	1,759	1,132	2,891	1,000 to 5,000
5,000 — 10,000	52	213	265	17	92	109		49	49		11	11	53	49	102	69	365	434	122	414	536	5,000 — 10,000
10,000 — 25,000	14	154	168	7	77	84		61	61		18	18	22	24	46	21	310	331	43	334	377	10,000 — 25,000
25,000 — 50,000	5	72	77		15	15		28	28		4	4	6	8	14	5	119	124	11	127	138	25,000 — 50,000
50,000 — 100,000	1	38	39		9	9		6	6		3	3	2	1	3	1	56	57	3	57	60	50,000 — 100,000
100,000 — 250,000	6	22	28		10	10		5	5		3	3	2	2	4	6	40	46	8	42	50	100,000 — 250,000
250,000 — 500,000	1	17	18		3	3		2	2		1	1			2	1	23	24	1	25	26	250,000 — 500,000
500,000 — 1,000,000		10	10		3	3					1	1					13	13		13	13	500,000 — 1,000,000
1,000,000 & over	1	7	8		5	5		1	1				4	1	5	1	14	15	5	15	20	1,000,000 & over.
GRAND TOTAL	1,902	1,778	3,680	86	376	462	3	269	272	1	71	72	854	237	1,091	1,992	2,494	4,486	2,846	2,731	5,577	GRAND TOTAL

PLANTS LOCATED IN CITIES TABULATED ABOVE—SERVICE BY OUTSIDE AGENCIES, CENTRAL STATIONS, TRANSMISSION LINES, ETC.

1,000 and under.	126	264	390	4	66	70	1	34	35		12	12	4	5	9	131	376	507	135	381	516	1,000 & under.
1,000 to 5,000	65	217	282	7	60	67		46	46		17	17	4	4	8	72	340	412	76	344	420	1,000 to 5,000
5,000 — 10,000	2	29	31		13	13		9	9		2	2				2	53	55	2	53	55	5,000 — 10,000
10,000 — 25,000		18	18		3	3		3	3								24	24		24	24	10,000 — 25,000
25,000 — 50,000		2	2					2	2								4	4		4	4	25,000 — 50,000
50,000 — 100,000		1	1														1	1		1	1	50,000 — 100,000
GRAND TOTAL	193	531	724	11	142	153	1	94	95		31	31	8	9	17	205	798	1,003	218	807	1,020	GRAND TOTAL

CURRENT NEWS AND NOTES.

NATIONAL TELEPHONE CONVENTION.—The National Interstate Telephone Association will hold its convention at Chicago during the progress of the Chicago Electrical Show. The convention dates are Jan. 21, 22 and 23, 1908.

A. I. E. E. MEETING.—The American Institute of Electrical Engineers will hold its two hundred and twenty-second meeting in the auditorium of the Engineering Societies Building, on Friday, Nov. 8, at 8:15 p. m., when Mr. A. H. Armstrong, of the General Electric Company, will read a paper entitled "Comparative Performance of Steam and Electric Locomotives."

TELEPHONES AS COMMON CARRIERS.—As a result of the sale of the Marion County Telephone plant, Marion, Ohio, to the Bell interests, trouble has arisen that will probably result in the courts being asked to decide whether telephone companies are common carriers. It seems that the United States Telephone Company has refused to accept messages from the company, and it has charged that both the long-distance companies are common carriers and are, therefore, compelled under the law to accept the messages. The Bucyrus Telephone Company, of Bucyrus, has refused to make a trunk-line connection with the Marion County plant, and it is believed that most of the other independent companies will do likewise.

SUICIDE BY ELECTRICITY.—A special cable despatch from London, of Oct. 20, says: "The story of what is believed to be the first case of suicide by electricity was told at the inquest at Kingston into the death of William Brown, secretary of the local football club. Brown was engaged as a carpenter at the electric lighting works, and it was stated that a little while before his death he made inquiries as to dangerous parts of the switchboard. It was supposed at the time he was anxious to avoid risking his life and the fullest information was supplied him. Subsequently he was seen with his hands on two of the terminals, and instantly thereafter he fell dead. The evidence showed he had had no worry, but had suffered from a religious mania, the recurrence of which he feared. A letter was found indicating his intention to commit suicide."

MANUFACTURE OF DIAMONDS.—A special cable dispatch of Oct. 26, from Paris, says: "Aristide Charette, a little-known chemist, attained sudden fame this week when a report was read before the Academy of Science telling how he had crystallized carbon by an entirely new process and had thus manufactured diamonds. A test tube with tiny diamonds attached to the sides was shown to the assembled savants and later submitted to analysis. Mr. Charette's method is as follows: A feeble electric current is made to pass during several days through sulphuret of carbon in the presence of iron. The operation is carried out in a vacuum, and thus electrochemically treated, the iron is transformed into sulphuret of iron, and the freed carbon being unable to combine with the oxygen in the air, is deposited in the form of crystals. Although very small, the light and brilliancy of these artificial diamonds equal that of the finest natural gems.

A. S. M. E. ANNUAL MEETING.—The fifty-fourth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York, Dec. 3 to 6, 1907. Symposiums on foundry practice, giving the experiences of prominent men in that work, have been arranged. The specific heat of superheated steam will be taken up, and a very important and exhaustive work by a professor of engineering at Cornell will be presented. The utilization of low-grade fuels in gas producers, combustion control in gas engines, tests of producer gas engines, etc., will be given a session. Other live topics, such as industrial education, power transmission by friction driving, cylinder port velocities, etc., will be discussed. All of these subjects will be treated by prominent engineers of Europe and America, professors of our universities, and men eminent in the particular work of which they write.

INCANDESCENT LAMP FILAMENTS.—Two patents were issued Oct. 22 to Eugene McOuat and Henry W. F. Lawrence, of Amsterdam, N. Y., on filaments for incandescent lamps. The patent earlier in date of application relates to a process which consists in dipping a carbonized core in a caramel solution containing finely divided metallic light-emitting particles in mechanical suspension, the coat thus deposited on the core then being carbonized. By this means, finely divided metals, including oxides or nitrides, are cemented together by particles of carbonaceous matter, and form a continuous and uninterrupted enveloping coat. The second patent relates to a process for making incandescent lamp filaments, which consists of incorporating a metal and silicon in the filament and forming a silicide by reaction between the metal and the silicon components. One method described consists in mixing with the usual filament cellulose material when in a plastic state, a quantity of a silicon and a metal, both in finely divided state, the amount being about 50 per cent of the plastic mass. The filament is then squirted and treated as usual, the heat when it is brought to incandescence serving to create the reaction which produces the silicide.

FOREIGN COMMERCE.—Advices from Washington state that with a view to rendering practical aid to the commercial and industrial interests of the United States and to the promotion of the foreign commerce of this country, Secretary Straus of the Department of Commerce and Labor has caused to be prepared a pamphlet by N. I. Stone, the tariff expert of the bureau of manufactures. The pamphlet contains a study of the commercial situation and conditions, together with a statement of the results already achieved by the Department of Commerce and Labor in promoting America's foreign commerce. It urges that "Congress be brought to a realization of the magnitude and the importance of this task," and give its support with funds commensurate with the work to be done. With a view to developing the most practical plan for rendering the department of greater service to the commercial interests of the country, and at the same time to enable the department to enlist the cooperation of such interests, Secretary Straus has invited the chambers of commerce and boards of trade from 20 of the leading cities of the country to appoint committees to meet in Washington on Dec. 5, to consider with him ways and means of accomplishing these objects.

FLAME ARC LAMP ELECTRODE.—Dr. C. P. Steinmetz has been granted a patent, dated Oct. 15, on an arc-lamp electrode of the type used in luminous arc or flame lamps. It is stated that during the operation of arc lamps of the type to which the patent relates, a fluid pool of molten metal exists at the top of the lower, and generally the negative electrode. The arc in its passage is carried by means of a bridge of vapor issuing from a point on the negative electrode and has apparently the characteristics of a high velocity blast, which causes a noticeable depression in the liquid pool. The arc, however, tends always to pass across the shortest distance between the electrodes, and, therefore, tends to climb up the sides of the depression, and in so doing, a new spot in the electric pool is depressed. The result of this action is a more or less rapid motion of the negative spot over the electric pool and a consequent tremble or rapid flicker of the arc flame. Instead of using a homogeneous mixture for the electrode from which the arc blast issues, the patent proposes a mixture consisting of a practically homogeneous body interspersed with refractory granules of 1/32 in. to 1/16 in. in diameter. When the liquid pool is formed, these grains project above the surface and serve to center the arc blast; except for relatively infrequent transitions of the arc from one granule to another, the arc flame thus remains absolutely steady. An electrode described is composed of powdered magnetite and tantalum intermixed with granules of chromite.

ILLUMINATING ENGINEERING LECTURES.—A course of 11 public lectures on illuminating engineering, under the auspices of the Department of Education, New York City, is being delivered in the Y. M. C. A. hall, 5 West 125th Street, New York. The lectures are delivered Wednesday evenings, by Mr. Theodore I. Jones, and will conclude Dec. 11.

PROTECTION AGAINST ACCIDENTS.—The Baltimore, Md., Gas & Electric Company has made a good point in one of its recent circulars advocating the use of electric motors. The circular on its title page calls attention to the fact that "protection against accidents to machinery and operators comes with electric-motor power;" and the text shows how starting rheostats, overload releases, no voltage releases, etc., speed controllers, etc., serve as safeguards and as protective devices in time of emergency. The point is well made, and cannot be too strongly urged.

HARD RUBBER SUBSTITUTE.—A patent issued Oct. 8 to Cæsar Marter, of London, England, describes a composite substance which is claimed to have some or all of the properties of vulcanite or ebonite, and which can be produced at a much less cost than these materials. Spent tan bark or bark containing considerable portions of tannin is reduced to a powder, with which is mixed from 25 to 33 per cent of sulphur. After heating the mixture, with continuous stirring, the coarse black powder resulting is allowed to cool, then ground to fine powder and placed in a suitable mold under pressure; the mold is then heated, and the contents set into a hard, durable mass of the shape of the mold and possessing the properties of vulcanite or ebonite.

CENTRAL STATION STATISTICS.—The September number of the *Central Station List,* just issued by the McGraw Publishing Company, contains the data of 5232 central-station plants in the United States, Canada, West Indies, etc. Of these, 220 are new, not having been enumerated before. No fewer than 2767, or more than half, carry lines of electrical supplies. The greatest number, though not the greatest capitalization, is shown in Illinois, with 385. New York, with the largest capital, has 318. Out of the total, 386 are credited to Canada and 44 to Mexico. Pennsylvania has 325; Ohio, 275; Michigan, 252, and Texas, no fewer than 208; while Indiana has 205, Indian Territory has already 33, Oklahoma Territory, 27, and Alaska, 6.

A BLEACHED COW.—George W. Eberhardt, superintendent of the municipal electric light plant at Lawrenceburg, Ind., reports a strange transformation of his cow. The cow was formerly a coal black animal. A wire from the pole of the electric street railway broke and struck the cow on the back. The animal dropped as though shot, but was soon on her feet again. She continued to tremble for three days. White spots were discovered in various places on the cow after a few days, which continued to grow until now the cow's hair is white. The theory is that fright and not the shock occasioned the complete transformation. Mr. Eberhardt has brought suit against the company for $100, because the cow has given no milk since the shock, although apparently in the best of health.

A. I. E. E. AT LAFAYETTE, IND.—The Purdue University branch of the American Institute of Electrical Engineers held a meeting on Oct. 18, in honor of Professor Benjamin, the new dean of the engineering school. After a brief address by Professor Benjamin, in which he expressed a deep interest in the institute, the discussion centered on the protection of electrical construction from damage by lightning. It was brought out by Professor Plumb that no arresters are in use at Purdue, and because of this omission the 3-kw transformer in the science building was disabled dusing a recent storm. Instances of trolley lines having been put out of service were discussed. A variety of lightning arresters were described by Professor Esterline, who said it was a bold move upon the part of any one to expound a theory of lightning arresters.

MISSOURI LIGHT ASSOCIATION.—The Missouri Electric Light Association was formed recently at St. Louis by representatives of electric and gas lighting and street car companies from different parts of the state. The meeting was held at the Marquette Hotel. The first officers of the association chosen, are at follows: President, Dr. J. D. Porterfield, of Cape Girardeau; first vice-president, W. B. Hays, of Poplar Bluff; second vice-president, W. H. Ledford, of Bowling Green; third vice-president, R. Irvine, of Marshall; secretary, C. Z. Pierson, of St. Charles. The executive committee consists of C. L. Clary, of Sikeston; Thomas Fox, of Cape Girardeau, and Harry Markham, of Brookfield. When the meeting was called the visitors were welcomed on behalf of the city by A. J. O'Reily, president of the Board of Public Improvements. Hugo Wurback welcomed them on behalf of the local electric supply men and Dr. Porterfield responded for the new association.

PRODUCTION OF GRAPHITE.—The U. S. Geological Survey has given out some data as to the production of graphite. Although this country consumes about 35 per cent of the world's total output of graphite it furnishes but 20 per cent of it. The amount imported into the United States in 1906, chiefly from Ceylon, was valued at $1,554,212, and the value of the domestic production was only $340,239. The purest graphite is carbon with 0.05 to 0.20 per cent of hydrogen, but the commercial grades of crystalline graphite contain clayey impurities, even the best, such as some of that from Ceylon, comprising as high as 15 per cent of ash. The production of artificial graphite has steadily increased since 1897, the year of its introduction, and the quantity manufactured in 1906—5,074,757 pounds, valued at $337,204—is the largest yet reported. The use of this product is being rapidly extended, and it probably comes into competition with the natural graphite in many lines of manufacture.

LEGISLATION IN CHICAGO.—A draft of a statute to compel the electrical equipment of all railroads in the city was completed by the council committee on state legislation, recently, and will be sent by Mayor Busse to Springfield with a recommendation for its enactment into law. Another proposed bill to enable the city to regulate public utilities so far as rates are concerned was laid over for further discussion. The law for the electrical equipment of railroads provides that in all cities of more than 200,000 population locomotives must be operated by electricity, compressed air or some other motive power which does not require steam or combustion on the locomotives. The railroads must make the change within three years after the law becomes effective. The railroad companies are made liable to a fine of $500 per day for each locomotive operated by steam after that date. Plans for the change must be submitted to the respective city authorities within six months after the passage of the law.

CORNELL UNIVERSITY.—The report of President Schurman to the Board of Trustees of Cornell University, which has just been issued, shows that for the year ending September, 1907, the total number of regularly enrolled students was 3523. Of this number 82 were studying architecture, 466 civil engineering and 1081 mechanical and electrical engineering. The report proposes a momentous change at Cornell University. Hitherto students upon graduation at the high schools have been admitted to the Cornell courses in law, medicine, civil, mechanical and electrical engineering, and architecture, and on completion of their professional courses have received the professional degrees. President Schurman's recommendation is that in the near future matriculants at Cornell University shall spend one or more years in the study of language, literature, history, economics, political science, etc., before admission to any professional courses of the University. It is noteworthy that of the total income of the University for the year 1906-7, $1,270,875.67, scarcely one-third—$409,873.51—was received from the students in the form of tuition, laboratory and other fees.

Remodeled Station of the Watertown Light & Power Company.

IN the early days of electric lighting, it was customary for the parent companies, as they were called, to install an exhibition electric-light plant in a town and light the business district. Local capital was then interested and the parent company would sell out to the stockholders. Thus was electricity introduced in Watertown, N. Y., in 1884, by the Excelsior Electric Company, of Brooklyn; most of the merchants subscribing for stock. Shortly afterwards several armatures were burned out by lightning during a severe thunder storm and many of the stockholders parted with their holdings to Messrs. D. C. Middleton and F. L. Baker. The latter died in 1895 and Mr. Middleton directed affairs until July, 1906, when the old company, the Watertown Electric Light Company, was bought by the present Watertown Light & Power Company.

The Black River, from which the Watertown Light & Power Company derives its power, has its source in the Adirondack Mountains and flows in a westerly direction into Lake Ontario, below Dexter, N. Y. The river is a rather rapid stream, so that from its source to its mouth, there is a chain of dams and falls; there being no less than 20 such dams with a total fall of 500 ft. in the last 30 miles of its length. Within the city limits of Watertown alone, there is a total drop of 112 ft. It can readily be seen, therefore, that with an average flow for nine months of the year of 10,000 cu. ft. of water per second, and with an average flow of 1771 cu. ft. per second at its lowest stage, the river is of vast importance to the villages and towns which line its banks. Most of the power is utilized by paper mills.

The power house of the Watertown Light & Power Company is well situated on the Black River as to center of distribution, being but a thousand feet from the public square, the center of business activity. At the power house site there is a natural fall in the river which is further increased by a low dam across the ledge of rock at the crest, making an available head of 32 ft. As previously stated, the first equipment consisted of Excelsior arc-light machines until 1889, when a 25-kw, 1100-volt, 125-cycle alternator was installed. With the growth of the city other alternators were added, until, in 1906, the rating of the alternating-current machinery aggregated 550 kilowatts. During this period there were also added two 62-kw, Thomson-Houston 500-volt generators and one 100-kw General Electric generator delivering current, also at a potential of 500 volts. Stationary motors only were used on the 500-volt circuits. Previous to the installation of the 500-volt generators, however, a fair-sized motor load was operated from the arc-light system. The motors used were of the Excelsior Company's make and gave good satisfaction. In fact, one of the motors rated at 10 horse-power, was in operation in the station until last spring. Previous to the installation of the first alternator, series and multiple-series incandescent lamps were fed from the arc-light dynamos, and it is interesting to note that from 1884 until late in 1906 the streets were illuminated by the same lamps, supplied from the same generators; or in other words the original equipment was operating until last year.

FIG. 2.—BLACK RIVER FALLS AT WATERTOWN.

When the present company assumed control, it was decided to scrap all the old belted machinery and to replace it with new and up-to-date, direct-connected machinery. To do this it was necessary to remodel the buildings to a great extent. At the same time it was decided to make them practically fire-proof, so that reinforced-concrete construction was used throughout. The old wooden flume was also replaced by one of reinforced concrete. The old wooden dam, however, is still used. This

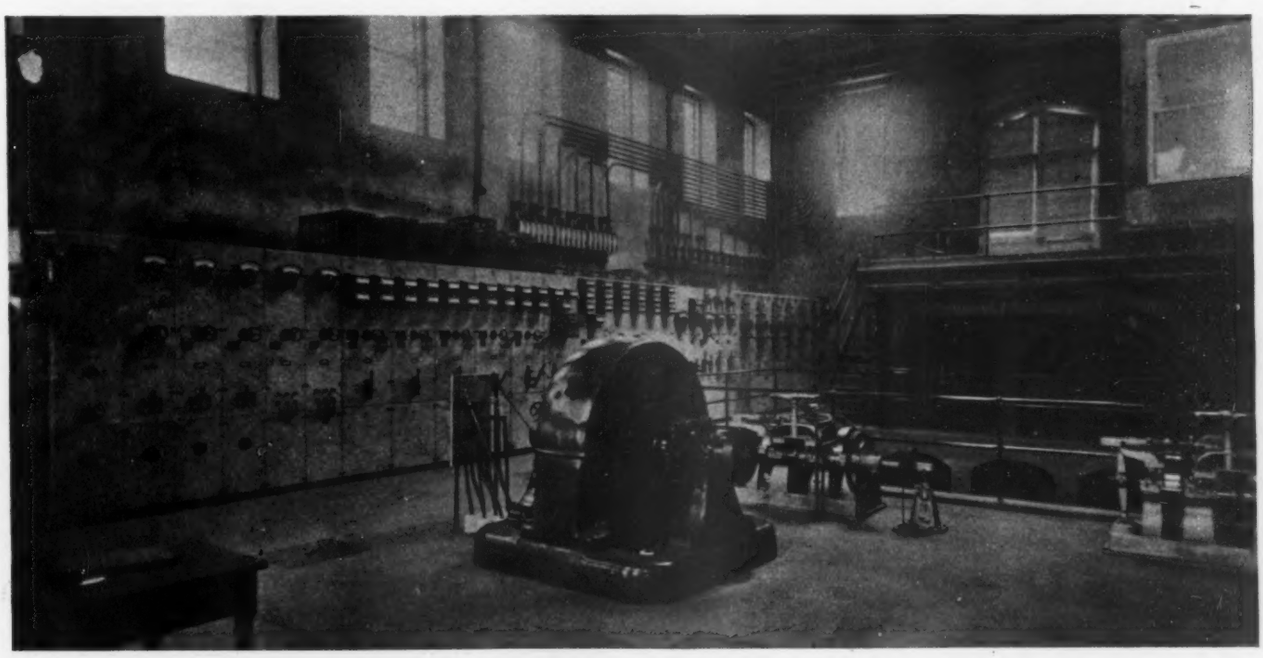


FIG. 1.—INTERIOR OF REMODELED STATION OF THE WATERTOWN LIGHT & POWER COMPANY.

is about 200 ft. long and is 10 ft. high. About 3600 horse-power is available at the falls, but of this the Watertown Light & Power Company has a right to only 1500 horse-power at normal flow.

With the rebuilding of the station, three Holyoke twin water-wheels were installed, each of which has direct-connected to it a 240-kw, three-phase generator. At the other end of the plant are two vertical wheels geared to a horizontal jack shaft. This shaft formerly drove small belted generators, but now has a 240-kw generator direct-connected to it by a flexible coupling.

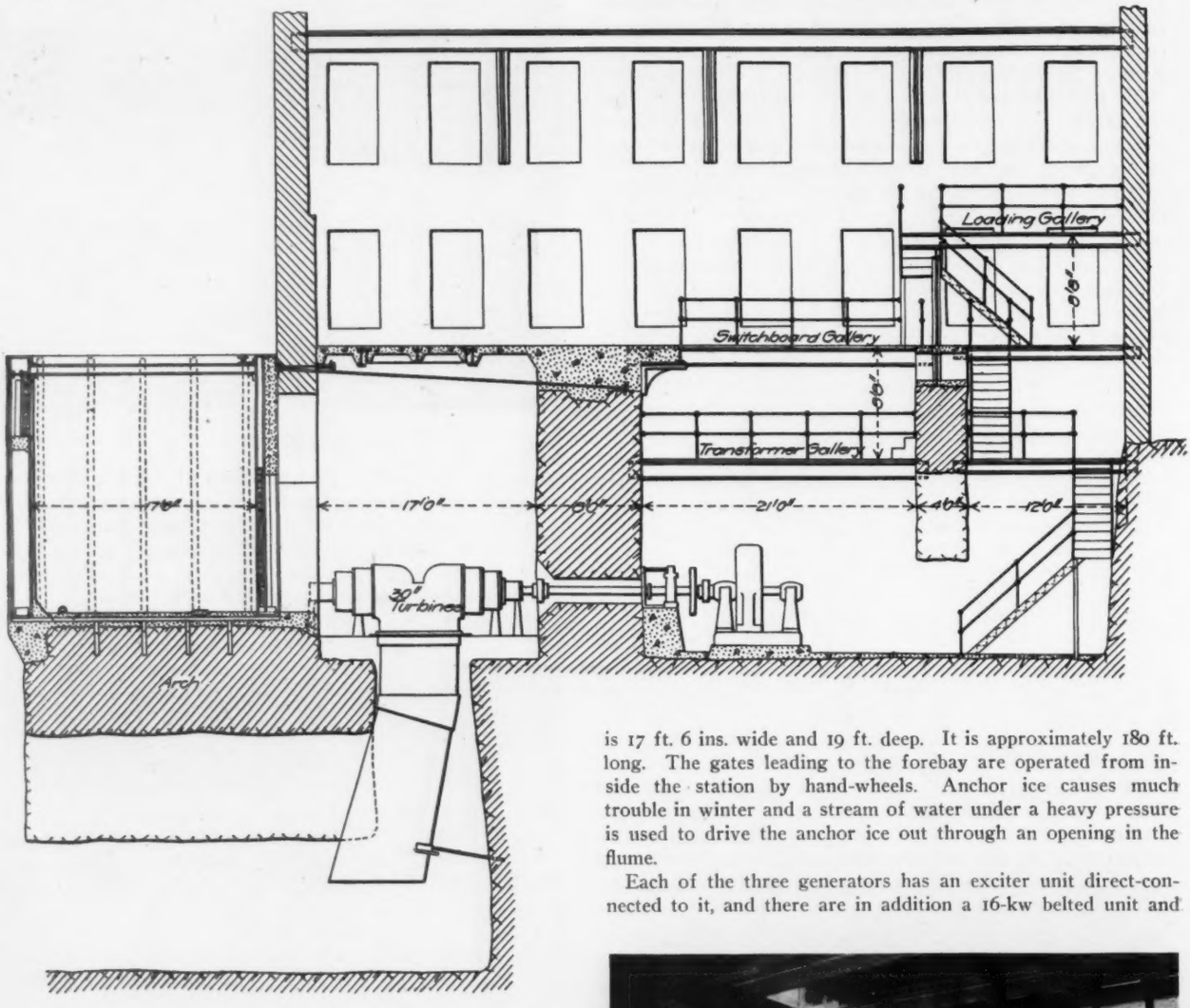


FIG. 3.—CROSS-SECTIONAL VIEW OF HYDRO-ELECTRIC STATION.

This water power was acquired after the original development, which accounts for its separation from the other water-wheel units.

Between the buildings housing the water-wheel generators, is the steam-driven apparatus. The old equipment consisted of a 400-hp Watertown Corliss engine and this has been replaced by a 1000-hp Quincy Corliss engine which is direct-connected to a General Electric, 600-kw generator delivering three-phase current at a potential of 2300 volts. Steam is obtained from two 500-hp Stirling water-tube boilers situated in a boiler room adjoining. The boilers are fitted with stationary herring-bone grates for burning bituminous slack and are hand fired. The furnaces operate under an induced draft supplied by a Sturtevant engine-driven, induced draft outfit. The feed-water will eventually be taken from the flume; but is at present purchased from the city. The ashes from the pits will be washed out into the river when the alterations are completed. A 10-in. pipe will run from a hopper across the flume to the river. The ashes will be thrown into the hopper and from there washed into the river by a stream of water under pressure. The engine is supplied with steam from a 14-in. header through a 10-in. pipe and separator, and will operate non-condensing. Because of the rock on which the station is built the engine is set five feet above the old floor on a concrete foundation. This was much cheaper than excavating and blasting and brings the floor even with that of the water-power plant.

Fig. 3 shows a cross-sectional view of the rebuilt water-power building, a general view of which is given in Fig. 1. The flume is 17 ft. 6 ins. wide and 19 ft. deep. It is approximately 180 ft. long. The gates leading to the forebay are operated from inside the station by hand-wheels. Anchor ice causes much trouble in winter and a stream of water under a heavy pressure is used to drive the anchor ice out through an opening in the flume.

Each of the three generators has an exciter unit direct-connected to it, and there are in addition a 16-kw belted unit and a 25-kw steam turbine-driven unit available for excitation purposes.

FIG. 4.—STEAM-DRIVEN UNIT.

The switchboard, shown in Fig. 1, is of the General Electric Company's standard type. The panels are arranged in the following order: One regulator panel, five exciter panels, six generator panels, three double feeder panels, one rotary converter

panel, three panels for 500-volt circuits, one panel for arc busses, and six mercury-rectifier panels for the street lighting system. The transformer equipment consists of six 50-light tub transformers, three transformers for the rotary converter and the necessary reactance coils for the mercury arcs. The feeders are carried in iron conduit from the switchboard to a

FIG. 5.—MAIN WATER-WHEEL-DRIVEN GENERATORS.

wire tower on one corner of the roof. This portion of the roof is concreted to make it fireproof, and the tower is constructed of iron with wooden cross arms.

The main part of the building is equipped with a traveling crane. A gallery extends across the north end of the building at the street grade, allowing a wagon to back to the doorway, where the load can be lifted by the crane.

The streets of Watertown are lighted by means of 250 magnetite arc lamps fed through 50 light mercury rectifiers. Multiple arc lamps are also used for commercial lighting. Motors are fed from a 500-volt circuit supplied by a 150-kw rotary converter. No more motors are being connected to the 500-volt circuits, however, and in time this service will be discarded altogether, alternating-current motors being used instead. The three feeder panels control six 2300-volt, three-phase circuits to which both motors and lamps are attached. Large motors are fed direct from the lines and small motors are fed from the secondaries of step-down transformers. The lines of the com-

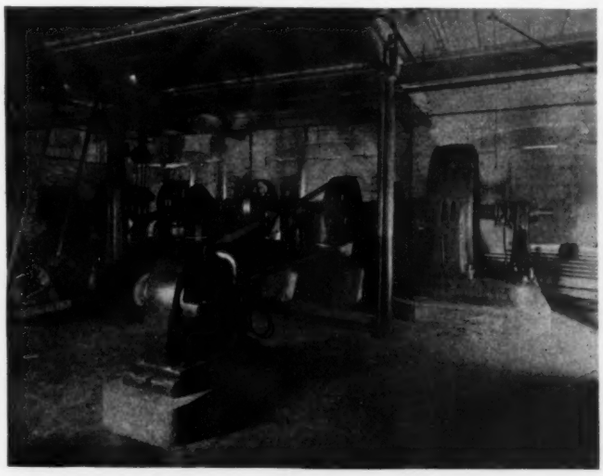


FIG. 6.—ALTERNATOR DRIVEN BY VERTICAL TURBINES.

pany aggregate 60 miles, entirely within the city limits, and are all overhead. The day load at present averages 550 kilowatts, and the night load averages 800 kilowatts. The connected load is approximately 1500 horse-power in motors and 50,000 16-cp equivalents.

The rates for energy for lighting circuits is 10 cents per kw-hour, subject to a 2-cent penalty for non-payment within 15 days. The rates for energy for motor circuits range from 10 cents to 2 cents per kw-hour. Arc lamps for street lighting bring $73 per lamp per year. On the 60-cycle alternating-current motor circuits the rates are as follows: A minimum charge of $1 per month per horse-power or fraction thereof is made on all motors up to 10 horse-power in size; on all motors from 10 horse-power to 50 horse-power, the charge is 50 cents per horse-power per month, and on all motors over 50 horse-power in size the charge is 25 cents per month. Energy is sold as follows:

For the first	50 kw-hours	10 cents per kw-hour
For the next	50 kw-hours	6 cents per kw-hour
For the next	100 kw-hours	5 cents per kw-hour
For the next	200 kw-hours	4 cents per kw-hour
For the next	200 kw-hours	3 cents per kw-hour
All over	600 kw-hours	2 cents per kw-hour

A discount of 5 per cent is allowed on bills paid before the 10th of the month. On the 500-volt circuits the minimum charge per month is the same as with alternating-current motors; but the rates for energy are 10, 7, 6, 5, 4 and 3 cents respectively.

The company has just recently started a new business department, never having been in a position before to take on much load. At present three canvassers and one manager are em-

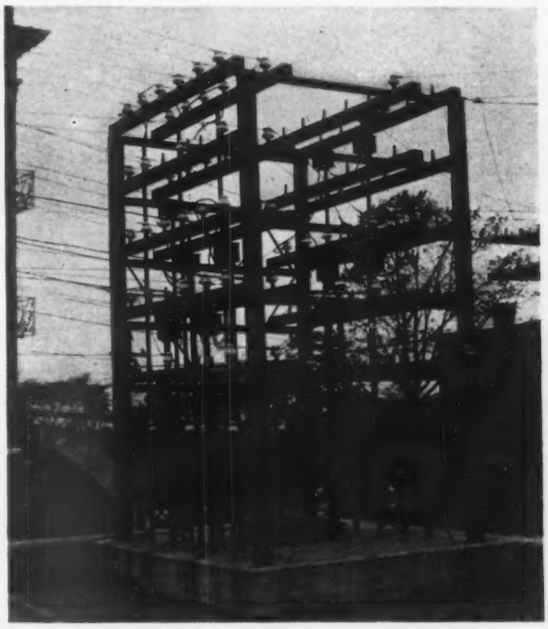


FIG. 7.—WIRE TOWER ON ROOF OF STATION.

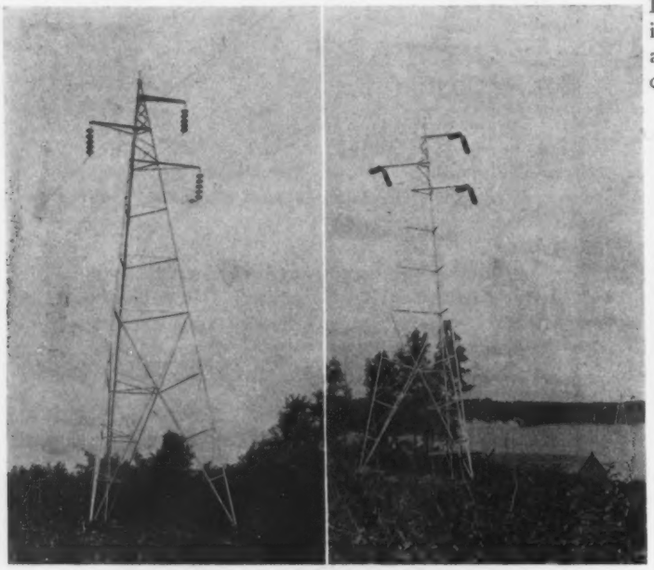
ployed. This department has not been in existence long enough to give any facts regarding its working.

The Watertown Light & Power Company has also purchased from the H. Remington & Son Pulp & Paper Company its water-power rights in the village of Black River, six miles above Watertown. The building and flume will be rebuilt, new water-wheels installed and a tail race excavated, etc. The head at this fall, as at present developed, is 20 feet and as the company owns all the water rights at this point, about 3500 horse-power is available. Pulp machinery was installed on all but one of the water-wheel units. To this one a 600-kw, 11,000-volt, three-phase generator will be direct-connected. The generator is now being erected, as is also the transmission line to Watertown. It is the intention to replace the pulp grinders with generators as business increases. The station at Watertown is now using all the water power available under its rights, and steam-driven units are required at times. All increase in demand will therefore have to be supplied from the station now building at Black River through the Watertown station.

The officers of the company are as follows: President, Mr. James T. Lynn; vice-president, Mr. George H. Babcock; treasurer, Mr. J. B. Taylor; secretary, Mr. F. A. Rogers; manager, Mr. J. I. Mange; and superintendent, Mr. J. C. Fagan.

The 100,000-Volt, Steel Tower Line of the Grand Rapids-Muskegon Power Company.

Descriptions have previously appeared in these columns of the wooden-pole line system of the Grand Rapids-Muskegon Power Company, which has been used for some time to trans-



FIGS. 1 AND 2.—VIEWS OF TOWER LINE.

mit electrical energy at voltages over 70,000. In order to provide a duplicate line over the most important link in this company's extensive transmission system, 35 miles of steel tower line is now being built between the Croton power plant, on the

FIG. 3.—SUSPENSION INSULATOR ASSEMBLED.

Muskegon River, to a sub-station in Grand Rapids. This line is designed for operation at 100,000 volts. It is being built over a right of way some distance from that of the wooden-pole line, in order that local thunder-storms may not affect both lines at the same time.

The triangular steel towers used on this line are from 40 ft. to 60 ft. high, and were built by the Aermotor Company, of Chicago. They are spaced about 500 ft. apart. Each leg is anchored to a 3-in. steel angle, 7 ft. 10 ins. long, buried in the ground. The steel angles are enclosed in concrete to prevent corrosion, except for about 10 ins. at the bottom, which is left bare to provide an effective ground for the steel towers. Stranded copper cables with hemp centers, and having a conductivity equal to No. 2 solid wire, are used for conductors. Figs. 1 and 2 show views of this line, and also the suspension insulators used. The conductors are hung from cantilever arms, two arms being placed on one side of the pole and one on the other.

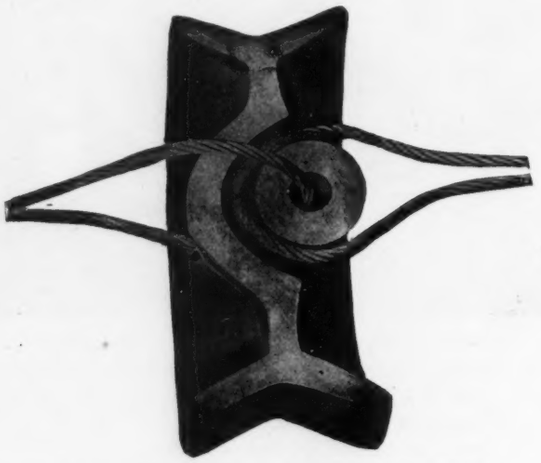


FIG. 4.—CROSS SECTION OF STRAIN INSULATOR.

The suspended insulators are of the type described by Mr. E. M. Hewlett in his paper presented at the last convention of the American Institute of Electrical Engineers, at Niagara Falls, June 26. Figs. 3 and 4 show the construction of the members of this insulator. Five of these insulators are suspended in series to insulate the line. The diameter of each porcelain link is 10 ins., and the rated voltage that each link will withstand is 25,000, although the links arc over when wet at approximately 65,000 volts each. Fig. 4, while showing the interior construction, also shows the form of petticoat on the insulator used in a horizontal position as a strain insulator at curves and at intervals to anchor the line.

The steel angles to which the links of the tower are anchored were set in concrete at a mixing plant at one end of the line and were afterward transported to points needed. Each complete anchor weighs about 275 lbs. The concrete envelope is elliptical in section, the axes of the ellipse being 4½ ins. and 6 ins., respectively. One 3-in., 4-lb. steel channel and several short reinforcing rods were fastened horizontally near the bottom of each main angle as anchors. These channels and rods also were enclosed in concrete discs; sheet-iron molds being used for that purpose.

Electrical Equipment of the Grosse Pointe Water Works.

Mr. H. P. Gunnison, at the convention of the Michigan Electric Association, on Aug. 22, gave some interesting facts regarding the motor-driven centrifugal pumps and equipment of the water works at Grosse Pointe, near Detroit. The villages of Grosse Pointe and Grosse Pointe Farms were formerly supplied with water by a small plant which also supplied electricity for commercial incandescent lighting in the village of Grosse Pointe Farms. The street lighting in the village of Grosse Pointe Farms was done by gasoline vapor lamps, which had been in use about six years, and sometimes a number of lamps in a row would be out of order at the same time. The water works were located 12 miles up the lake in an aristocratic residence district and had no railway facilities, so that coal had to

works were located 12 miles up the lake in an aristocratic residence district and had no railway facilities, so that coal had to be hauled from the city. The rates were very high, and electric lamps were used only by the wealthy citizens, who perhaps lived in the city during the winter. The electric light and water company barely managed to exist, and its patrons were complaining both of the service and of its cost, while neighboring villages were well supplied from Detroit at much cheaper rates. The water rates were $1.80 per 1000 gals.; the electric light rates 40 cents per kw-hour from Oct. 1 to May 1, and 20 cents from May 1 to Oct. 1.

The Peninsular Electric Light Company, which retails energy for the Detroit Edison Company in outlying districts around Detroit, in looking for new business, found this district a very desirable one to increase its summer load, but it was not desirous of going into the water works business. However, in order to get a contract for furnishing electricity for lighting, it was also necessary to pump the water. An appraisal was made for the Peninsular Company by Mr. C. W. Hubbell, civil engineer, who also made the selection of pumps and designed the water works plant hereinafter described. The Peninsular Electric Light Company purchased the water works plant under a contract whereby the village at the end of a 10-year contract may purchase the equipment at an appraised valuation. The company extended a three-phase, 4600-volt transmission line from an adjoining village to the water works. A three-phase automatic regulator is used for maintaining the voltage on the commercial lighting circuits. The village distributing e. m. f. was changed from 1000 to 2200 volts, and small transformers were replaced by larger ones, capable of carrying the load of several customers.

The electrical energy for operating the Grosse Pointe water works is generated at the steam turbine station at Delray and is transmitted underground to the easterly limits of Detroit by three-phase, 4600-volt cables and then overhead on three No. 2 bare wires to a transformer house in the rear of the water works, where the e. m. f. is stepped-down to 2200 volts, which value is used directly on the pumping station motors. The transmission line is designed for 22,000 volts, both on the underground and overhead portions, and soon will be operated at this e. m. f. The switchboard at the water works has eight panels, one for the commercial lighting circuit, one for the series alternating arc circuit, two for series incandescent lamp circuits, one for each of the three pump motors, and a totalling panel.

After receiving prices and guarantees from four makers of centrifugal pumps as to power consumption, duties and characteristics, three De Laval pumps were ordered. Two of these were two-stage pumps of 400 gals. per minute capacity, with 4-in. suction and discharge pipes, and driven by 35-hp, 2200-volt, three-phase, 60-cycle induction motors. The third unit, for fire service, was a three-stage pump of 1600 gals. per minute capacity, driven by a 75-hp induction motor. This pump has 8-in. suction and discharge. The guaranteed mechanical efficiency was 60 per cent for the small pumps and 64 per cent for the large one. This guarantee was fulfilled and, in fact, slightly exceeded by accurate tests made at the factory before the pumps were accepted.

The steel reservoir tank for holding the water has its bottom 55 ft. and its top 88 ft. above its foundations, and the foundations are 20 ft. above the pumps. Its capacity is 100,000 gals. These pumps take up very small floor space, considering their capacity. The small pumps are 3 ft. wide by 6 ft. 8 ins. long, and the large one 4 ft. x 10 ft. The pumps are not self-priming. The suction pipe must be absolutely air-tight and the system designed so that the suction pipe can be filled before attempting to start the pumps. These requirements have been met, and the installation has given no trouble whatever since its installation.

The meter at the plant, according to which the output of water is measured and paid for by the village, is a 10-in. Premier meter of the Venturi type, made by the National Meter Company. It has a 4-in. throat opening and registers correctly within very wide limits; 200 gals. per minute being thought to be about the average, the maximum being about 1600 gals. in case of fire, and the minimum 50. A Crosby gauge reading to 100 points and also a Bristol recording commercial gauge are connected to the water system at the plant. The gauge is connected with the suction, which indicates either pressure or vacuum. No telltale float is used on the tank, as the pressure on the gauge indicates the height of water in the tank more satisfactorily than a telltale. The pressure of the water is maintained between 45.5 lbs. and 37 lbs. per sq. in. The town water supply system is maintained by running one pump for from three to six hours per day, depending on the particular season of the year.

TESTS.

The amount of water, in gallons, pumped from Feb. 1 to Aug. 1 was as follows:

February	2,079,800
March	1,765,600
April	2,017,800
May	2,801,700
June	3,642,500
July	3,928,900
Total	16,236,300

For July 933 gals. of water were pumped per kw-hour. If the village had paid for energy at 4 cents per kw-hour, the energy would have cost 20 per cent less than the coal burned for the month of July, 1906. Some experimenting was done, however, which made the reported energy consumption for this month somewhat larger. Tests on the water meter were not as extensive as they would have liked, nevertheless they justified the conclusion that the meters were registering very close to the makers' guarantee, which was 5½ per cent slow at 100 gals. per minute; correct at 208 gals. per minute; 2 per cent fast at 348 gals. per minute.

In the discussion following the reading of the paper, Mr. E. F. Phillipps, of Detroit, brought out the point that the Peninsular Electric Light Company pumps water for the village of Grosse Pointe Farms at $40 per million gals. for the first 50,000,000 gals. pumped, with a minimum of $2,000 per annum; for the second 50,000,000 gals. $20 per million, and for any excess over 100,000,000 gals., $15 per million, the payment being based entirely on the gallons of water pumped rather than on the kw-hours of energy.

Mr. Gunnison being asked as to the possibility of operating such a system automatically without an attendant, said it would not be safe on account of the suction, which is from 16 ft. to 20 ft. in height, varying with the rise and fall of the lake. Sometimes a little air creeps in and the pumps accumulate enough air in the upper chamber to lose their suction. There are remote control motors on the market, and if one can put in a centrifugal pump below the water level so that it would be primed at all times and ready to pump, this system could be used. An ideal equipment would be a vertical deep-well centrifugal pump to raise water at a reservoir and another pump to supply water to the tank and system. Mr. Gunnison further stated that this equipment could be worked automatically, as there would be no danger of the deep-well centrifugal pump losing its suction.

President Chandler said that the pumping question is one of the most important that is at the present time before electric lighting companies. There are few places in the state where the question is not worth investigation. The lighting company should be able to pump the water for the city and save the city a large proportion of the amount it is paying for the present steam pumping and make money for the electric light company.

Mr. Marshall asked whether the water meter is considered accurate enough for an electric light company to make a certain charge per thousand gallons instead of per kw-hour. City officials and water commissioners are usually more favorable to basing a contract on water pumped rather than kw-hours. Mr. Phillipps replied that the Peninsular Electric Light Company has confidence enough in the water meter to do so at the prices previously mentioned.

Direct-Current Motors, Their Action and Control—I.

By F. B. Crocker and M. Arendt.

MANY types of electric motors are manufactured and each has its characteristics of design and operation. In general electric motors may be divided into those of the direct- and alternating-current groups, and these may be subdivided into particular types. The types of direct-current motor are as follows:

DIRECT-CURRENT MOTORS.

Type.	*Operative Characteristics.*
Shunt-wound motors.....	Starting torque usually 50 to 100 per cent greater than rated running torque, and fairly constant speed over wide load ranges.
Series-wound motors.	Powerful starting torque, speed varying greatly (inversely) with load changes.
Compound-wound motors.....	Compromise between shunt and series types.
Differently-wound motors.....	Starting torque very small, speed can be made almost absolutely constant for load changes within rated capacity.

The conditions under which machinery operates, in regard to varying speed and power required of the driving motor, may be divided into four classes, and certain types of motors are usually best suited to these divisions, which are as follows:

(a) Work which requires the motor to operate automatically at a practically constant speed, regardless of load changes or other conditions.

(b) Work requiring frequent starting and stopping and wide variations in speed, including sometimes rapid acceleration.

(c) An approximately steady load or work that varies as some function of the speed should it change.

(d) Work in which the power varies regardless of the speed, or where speed variations with constant torque may be desired.

The first case (a) applies to line shaft equipments with many machines operated by the same motor and where slight speed variations may be allowed; the direct-current shunt or slightly compounded motor or the alternating-current induction motor would answer, depending naturally upon the character of electric current available. A refinement of this problem is encountered in the driving of textile machinery, especially silk looms with which even a slight speed variation might affect the appearance of the finished product. In such instances the alternating-current motors, polyphase induction or polyphase synchronous, are generally employed because the speed of direct-current motors varies considerably with voltage changes and the variation in temperature which occurs after several hours of operation, whereas, the speed of the alternating-current motors, unless the voltage varies greatly, is primarily dependent upon the frequency of the supplied current.

The second class (b) is divided into two parts, the first being electric traction and crane service, in which the motor is frequently started and stopped and rapidly accelerated at starting; or where the speed is to be adjusted automatically to the load, slowing down when heavily loaded or climbing a steep grade. These conditions are well satisfied by the series motor of either the direct or alternating-current types, depending upon the current supplied. Elevator service is of this character as regards frequent starting and stopping, but after rapid acceleration it calls for a speed independent of the load. Hence, to fulfill both requirements, elevator motors when of the direct-current type are heavily over-compounded to give the series characteristic at starting; then, when the motor is up to speed, the series field winding is short-circuited and it operates as a shunt machine. Recently, however, two-speed shunt motors have been employed for this service, the field being of maximum strength for starting and sparking prevented by use of interpoles. If only alternating current is available the polyphase induction motor should be employed, but for powerful starting torque either slip-ring or compensator control would be necessary. For the second subdivision of this class the motor must be started and stopped frequently and not rapidly accelerated, but on the contrary, simply "inched" forward at the start, as in the operation of printing presses, gun turrets, etc. These conditions of service are satisfied by a direct-current compound motor provided with double armature and series-parallel control of the machine, as, for example, that manufactured by the C. & C. Electric Company. This character of work is also well performed by having a double or variable potential source of current supply for the working motor, low voltage being used for starting and "inching" and higher voltages for running. These features are supplied by the Bullock "teazer" system, by the Holmes-Chatworthy two-motor method, or by the Ward-Leonard motor-dynamo equipment; the latter, however, being somewhat expensive its use is almost entirely restricted to the operation of gun turrets and such special service, in which cost is a secondary consideration.

The third class (c) of work is the operation of pumps, fans or blower equipments and its requirements are satisfied by the series motor, whose speed adjusts itself to the work, and also because it exerts the maximum torque required at starting. It must be, however, either geared or directly connected to the apparatus, because the breaking of the belt or the sudden removal of the load would cause a series motor to race and become injured. The operation of pumps by electric motors is usually effected by gearing, since ordinary plunger pumps do not operate efficiently if driven in excess of fifty strokes per minute, and to accomplish this by direct connection would demand a very low speed and costly motor. Centrifugal pumps operating at high speed may be direct driven.

The fourth class (d) is found in individual machine-tool service, for which the maximum allowable cutting or turning speed requires the number of revolutions of the work or tool to vary inversely as the diameter of the cut. This condition is satisfied best by the direct-current shunt or slightly compounded motors, as they are readily controlled in speed by variation of the applied voltage, shunt field weakening, etc., as described later.

It is to be noted that *a* and *c* regulate automatically to maintain a constant speed, while *b* and *d* are controlled by hand to give variable speeds. Furthermore, *b* is usually under control of the hand all the time, whereas *d* is set to operate at a desired speed for some time and regulates automatically when so adjusted.

The Speed Classification of Motors recommended in the Standardization Rules of the American Institute of Electrical Engineers is as follows:

1. *Constant-speed motors,* in which the speed is either constant or does not materially vary, such as synchronous motors, induction motors with small slip and ordinary direct-current shunt motors.

2. *Multispeed motors* (two-speed, three-speed, etc.), which can be operated at any one of several distinct speeds, these speeds being practically independent of the load, such as motors with two armature windings.

3. *Adjustable-speed motors,* in which the speed can be varied gradually over a considerable range; but when once adjusted remains practically unaffected by the load, such as shunt motors designed for a considerable range of field variation.

4. *Varying-speed motors,* or motors in which the speed varies with the load, decreasing when the load increases, such as series motors.

DIRECT-CURRENT SHUNT MOTORS.

Let us consider first the action of shunt-wound motors under various conditions of load, temperature, speed, etc. To make the results as significant as possible, standard shunt-wound machines have been selected as examples. Three sizes are taken, *i. e.*, 1, 10 and 110 horse-power. It is to be remembered that the

average size of motors is less than that of generators, several of the former being usually fed by one of the latter. Hence these sizes represent small, medium and fairly large machines. It is also a fact that the 110-hp size is sufficiently large so that still larger motors will correspond closely. For example the efficiencies of the three sizes are about 81, 86 and 93 per cent, respectively, above that the efficiency would increase only 1 or 2 per cent. Therefore, the characteristic diffierences are found below 110 horse-power, and these machines may be taken to represent commercial practice, using shunt motors.

A few simple tests determine the fundamental facts from which the action of these machines under almost any reasonable conditions may be readily calculated. Most of the tests are well known, but they are included here as a desirable part of the definition of the fundamental quantities to avoid any uncertainty in regard to them.

1. *The Voltage V,* for which the motor is designed and at which it normally operates, is assumed to remain constant, being applied to the terminals of the armature and field circuits, which are in parallel (Fig. 1). If V is not constant it should

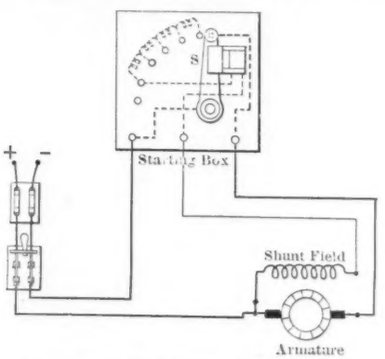


FIG. 1.—SHUNT MOTOR CONNECTIONS.

be maintained so (for experimental investigation) by inserting a rheostat which can be adjusted to correct any variations. This voltage should be that marked on the manufacturer's name plate and is generally known as the rated voltage. It may be found later that some other voltage is preferable in order to obtain a different speed or other result, in which case a new series of tests should be made at the modified voltage.

2. *The Total Current I* taken by the motor at rated load is also marked on the name plate. This may be found later to differ from the current at which the rated horse-power is developed, or it may cause heating in excess of the limit specified in (4). In either case another series of observations should be taken with the corrected current. For the present, however, it will be assumed that the rated voltage V and the rated current I are both correctly given on the maker's name plate.

3. *The Room Temperature t* is taken at 25 degs. C. in standardizing electrical apparatus. If it differs from 25 degs. C. allowance should be made.

4. *The Temperature Rise* Θ permissible in the armature or field is 50 degs. C. as measured by increase in resistance of these respective windings. This gives a working temperature of $t + \Theta = 75$ degs. C. $= T$, at which the machine is said to be "hot" in contradistinction to "cold" at the room temperature t. To determine whether the temperature rise Θ is within the limit of 50 degs. C., the motor is supplied with the rated voltage V and operates with sufficient load to draw the rated current* Ia until a constant temperature T is reached, requiring from 6 to 18 hours, depending upon the size, speed and ventilation of the machine. The resistance of the field and armature circuits is measured before, during and after the run, as explained in (5) and (6). This resistance at 25 degs. C. is $R_0 + (.0042\, R_0 \times 25) = 1.105 R_0$ and at 75 degs. C. it is $R_0 + (.0042\, R_0 \times 75) = 1.315\, R_0$, where R_0 is the value at 0 deg. C.

Hence the resistance at working temperature or "hot resistance" is as 1.315 : 1.105 :: 1.19 : 1, or 19 per cent greater than the "cold resistance." If the increase in resistance is found to be less than 19 per cent so much the better, not only for safety, but also for constancy of speed as shown later.

5. *The Field Current* I_{sh} in the shunt motor is determined by connecting the field terminals directly to the supply circuit, the voltage of which is V. This should be measured when the machine is "hot," that is, after the run specified in (4) to obtain working conditions. The field current should also be determined with the machine "cold," before the run, because speed variations are caused by the temperature changes, as explained later. Furthermore, with both values known, the increase in resistance and temperature rise may be easily calculated. The shunt field resistance "hot" $R_{sh} = V \div I_{sh}$ and the corresponding values cold are $R'_{sh} = V \div I'_{sh}$, from which $R_{sh} \div R'_{hs} = I'_{sh} \div I_{sh}$. With temperatures of 75 deg. and 25 deg. C., respectively, it was shown in (4) that $R_{t+\theta} \div R'_t = 1.19$, hence $I'_{sh} = 1.19 I_{sh}$. In any case, however, the temperature rise in degrees C. is $\Theta = (238.1 + t_1)\left(\dfrac{R_1}{R''} - 1\right)$ where t_1 and R_1 are the initial temperature and resistance, while R'' is the final temperature.

6. *The Armature Resistance, Ra* including resistance of brushes and brush leads, but not brush contacts, is also measured "hot." Potential difference or voltage "drop" due to the brush contacts which depends upon the current density should be measured at the rated current value and deducted from the total drop in the armature circuit, to get the true resistance of that circuit, or that quantity which multiplied by the current gives the IR drop. The armature before it has time to cool off after the run, is supplied with its rated current I_a, but is not allowed to rotate, under which condition suitable resistance must be inserted in series to compensate for the absence of counter e. m. f. The total drop V' in volts across the armature terminals is then measured, also the drop D_b due to the brush contacts, and we have $R_a = (V' - D_b) \div I_a$. The armature circuit resistance "cold," if entirely of copper, is then $R'_a = R_a \div 1.19 = .84 R_a$, assuming "cold" and "hot" temperatures of 25 degs. and 75 degs. C., respectively. As a rule, however, since the armature circuit resistance includes that of the carbon brushes, which latter have a negative temperature coefficient, the total increase between 25 degs. and 75 degs. C. is about 15 per cent, or $R'_a = R_a \div 1.15 = .87 R_a$. This variation in armature resistance is not very important, however, as it will be shown later that it has little effect upon the efficiency, regulation, etc., of the machine.

Before proceeding with the various problems to be considered in connection with electric motors, it is desirable first to study their counter electromotive force as it plays an exceedingly important part in the action of such machines.

The counter e. m. f. of a motor armature is the e. m. f. that it would develop as a generator when operated at the same speed and field strength.

Let Φ = flux entering or leaving the armature per pole
n = total number of inductors on the armature
N = revolutions per minute
p = number of pairs of poles
b = number of circuits in parallel in the armature winding

then e = c. e. m. f. of motor armature $= \dfrac{\Phi n N_2 p}{60 \times 10^8 \times b}$ (V)

By inspection of the equation (V) it can readily be seen that with Φ, n, p and b maintained constant, the c. e. m. f. varies directly with N the number of r. p. m., and conversely we may state that the speed of a motor varies directly as the c. e. m. f., other factors being constant. This is a very important fact, especially in shunt motors, because these quantities do remain practically constant unless purposely varied. The c. e. m. f. can be calculated if the various quantities listed above are known.

Experimental Method of Determining the C. E. M. F.—The armature shaft may be fitted with a heavy flywheel, so that the stored energy in the revolving parts is great. The motor is then operated without load, but at rated speed by slightly re-

*Standardization Rules, Amer. Inst. Elec. Eng., 1907.

ducing the voltage applied to the armature by introducing resistance, while the field is excited with the proper line voltage V. When the rated speed is attained, the armature circuit is suddenly opened, while the flywheel effect will cause the armature to maintain almost constant speed for a short time, during which the c. e. m. f. can be measured by a voltmeter since it then becomes the e. m. f. of the machine acting as a generator.

2. *Determinations of C. E. M. F. from True Torque of a Generator or Motor.*—Connect the field windings to the supply lines, and allow rated field current I_{sh} to pass through them; then connect the armature to the mains, through such resistance that the rated load current I_a flows through its winding, but develops only a static torque (*i. e.*, armature not revolving). Attach a brake arm or lever of known length to the machine pulley and measure in pounds the pull plus friction of bearings and brushes, also the pull minus friction, add these together and divide by two, the result muliplied by the length of brake arm in feet will be the true torque (T_t) provided the weight of arm or lever is eliminated. Then at any speed N in r. p. m., the total power developed would be $2\pi T_t N$ foot-pounds per minute, which divided by 33,000 is the total mechanical horse-power evolved in the armature and corresponds to the indicated horse-power of a steam engine. This must equal the electrical horse-power supplied to the armature, hence

$$\frac{2\pi T_t N}{33{,}000} = \frac{EI_a}{746}, \text{ or } E = \frac{2\pi T_t N 746}{33{,}000 I_a} = \frac{T_t N}{7.03 I_a} \qquad \text{(VI)}$$

Where E is the motor *c. e. m. f.* or generated voltage at any speed N. The true torque or turning effort of a motor depends upon the armature current, the number of armature inductors and the flux through the armature. It is independent of the speed and the equation for the determination of its value is $T_t = KI_a\Phi$, where K is constant, depending upon the number of poles, effective conductors, etc. This true torque includes not only the effective torque developed by a motor at its pulley when running, but also the torque required to overcome friction, windage and core losses. In the case of a generator, the total torque is that necessary to revolve the armature and overcome friction, etc. Hence effective motor torque + (friction + windage + core loss torque) = true torque = generator torque — (friction + windage + core loss torque).

In the case of belt-driven machinery, the effective torque is equal to the difference in tension on the two sides of the belt multiplied by the radius of the pulley in feet.

Calculation of C. E. M. F.—In the armature circuit of a direct-current shunt motor the applied voltage, V, overcomes three factors, namely, resistance drop, brush contact drop and the c. e. m. f.; hence, $V = I_aR_a + D_b + c.\ e.\ m.\ f.$, or rearranging $c.\ e.\ m.\ f. = V - (I_aR_a + D_b)$. (VII.)

Electric Light and Power at Danbury, Conn.

By William H. Stuart.

Danbury, Connecticut, is a city of some 22,000 inhabitants, the county seat of Fairfield County, and the center of a truck-farming district. Danbury is noted for its hats, their manufacture being its principal industry. Scattered through the city are more than two score hat factories, and also a number of factories for the production of hat-making machinery.

The first electric light plant was started in Danbury along about 1888, and was known as the Schuyler Electric Light Company. The Schuyler Electric Light Company existed for a period of one year, when a consolidation was made with the Danbury Gas Light Company, and the new concern assumed the title of the Danbury & Bethel Gas & Electric Light Company.

The station is a two-story brick building, containing the engine and dynamo room, boiler room, office, store room and meter room. The equipment consists of four Heine boilers, two of 300 hp and two of 150 hp. There are two Buckeye engines of 150 hp direct-connected to two 150-kw, 2300-volt generators. The voltage is 220 volts for motor service and 110 volts for lighting. A 500-kw Curtis steam turbine is now being installed to be run from the present batteries of boilers. The engine room is large and well-lighted, with a concrete floor. The switchboard is on the floor level, and made up of 15 panels. Behind the engine room is the office of the superintendent, the storeroom and the meter room. There is also a large locker room fitted up for the station employees. Coal is received on a spur from the railroad and hoisted to a large bin, and is delivered to the boiler room by an industrial railway. The boilers are fired by hand, although within a very short time mechanical stokers will be installed. The ashes are taken away in carts and dumped in a swamp near the station as filling.

Distribution is by means of pole lines, Danbury as yet having had no agitation, political or otherwise, toward requiring the placing of its mains underground. Transformers are all placed on the poles and used individually, save at two congested points, where they are grouped. The arc circuits are tested out every day before the current is turned on for grounds, crosses and open circuits. The arc system is operated on six circuits with from 19 to 24 lamps on each. The contract with the city requires that 130 1200-cp enclosed arcs be burned until 1 a. m on the moonlight schedule. The company is now negotiating with the town of Bethel to illuminate the streets with about 40 arcs of the enclosed type. The commercial lighting shows a connected load of about 4500 incandescent lamps, 16-cp equivalent.

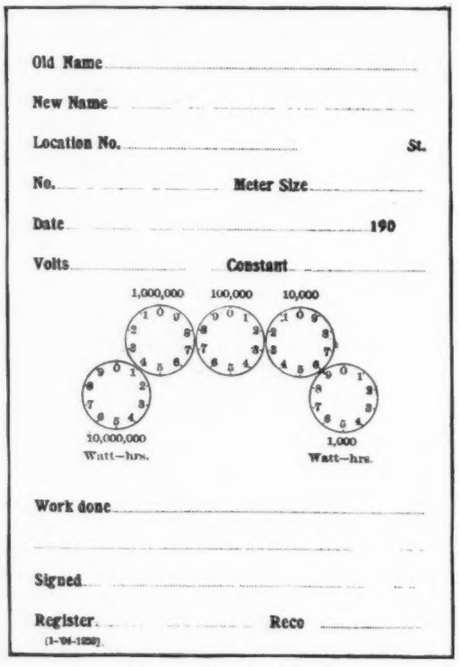


FIG. 1.—METER CARD.

The power load is about 900 hp in motors, 10 per cent of which are for 110 volts and the remaining for 220 volts. The station load during the summer months reaches its peak at from 9 a. m. to 11 a. m., when the motor load is heaviest. In the winter months the peak occurs at 5 p. m. when the motor and the lighting loads lap. During the month of August, 1907, the total output was 105,000 kw-hours, and in December will probably reach 130,000 kw-hours. The Danbury Company had to discontinue taking on new business in the spring on account of the station having reached its maximum capacity; this condition will of course be changed when the 500-kw turbine unit is started up.

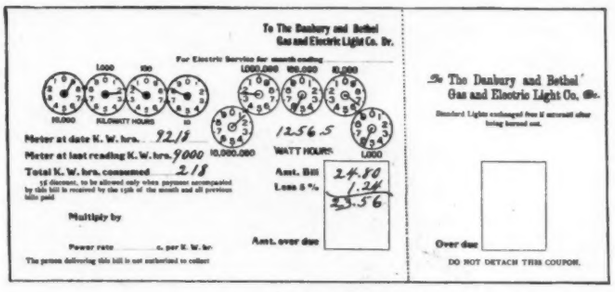
The force maintained to operate the station consists of a superintendent and an assistant, three engineers, three firemen, five linemen, one meterman and a laborer.

When a meter is received from the factory, it is tested in the meter department, given a number, and placed in stock. When sent out the form reproduced in Fig. 1 is filled out in full and then filed away. A card record of the meters is also kept which includes the information on this form. All changes, tests and repairs are noted on the cards under respective dates. When a consumer complains of high bills and requests that the meter

be tested, it is replaced by another and the questionable one brought to the station for testing. If found to be in good condition and to register correctly, it is placed in stock again and the consumer informed as to the result of the test. If the meter was at fault and fast, a proper credit is made on the consumer's bill.

The meters are read at the end of each month. The readings are taken by men who have no connection whatever with the meter department at the station. Instead of an index book or card, blank bill forms with the name and address of the consumer are used. The meter reader draws in pencil the index hands in their exact position over the dials of the meters. When returned to the office, the bill clerk gets the previous month's reading from the ledger and computes the amount of the bill. The bills are delivered, but the carrier does no collecting, collectors calling later in the month. A reproduction of a bill is given in Fig. 2. The coupon shown is detached when the bill is paid. The same form is used both for the lighting and power service. Fig. 3 shows the reverse side of the bill, which gives the rates for both lighting and power service, and also the "Rules and Regulations" the consumer agrees to abide by when signing an application for electricity. On the stub will be noted a little reminder for large consumers, the only advertising matter appearing on the bill.

The offices of the company are located in the center of the city in the Public Library Building on Main Street, and have two large windows facing the street in which from time to time are placed various electrical displays. In going to the office


To The Danbury and Bethel Gas and Electric Light Co. Dr.

For Electric Service for month ending

Meter at date K. W. hrs. 9218

Meter at last reading K. W. hrs. 9000

Total K. W. hrs. consumed 218

Amt. Bill 24.80

Less 5 % 1.24

23.56

Multiply by

Power rate ... c. per K. W. hr.

Amt. over due

Over due

The person delivering this bill is not authorized to collect

To The Danbury and Bethel Gas and Electric Light Co. Cr.

Standard Lights exchanged free if accurate after being burned out.

1256.5

WATT HOURS

1,000

DO NOT DETACH THIS COUPON.

FIG. 2.—ELECTRICITY BILL.

to pay a bill, make a complaint or to transact any business, the visitor passes through the show room, which contains various electrical heating and cooking appliances, arranged so that a quick, practical demonstration can be afforded an interested person.

Fig. 4 shows a copy of the application for electrical service a consumer is asked to sign. Mr. Hodgson, the electrical superintendent, in commenting on its brevity, said that he believed it was just as binding and more satisfactory than an application containing a great many clauses which, when boiled down, amounted in the end to about the same thing. After experimenting, he found that a simple, short form caused less hesitation about signing on the prospective consumer's part, than did the form of contract including a number of legal clauses.

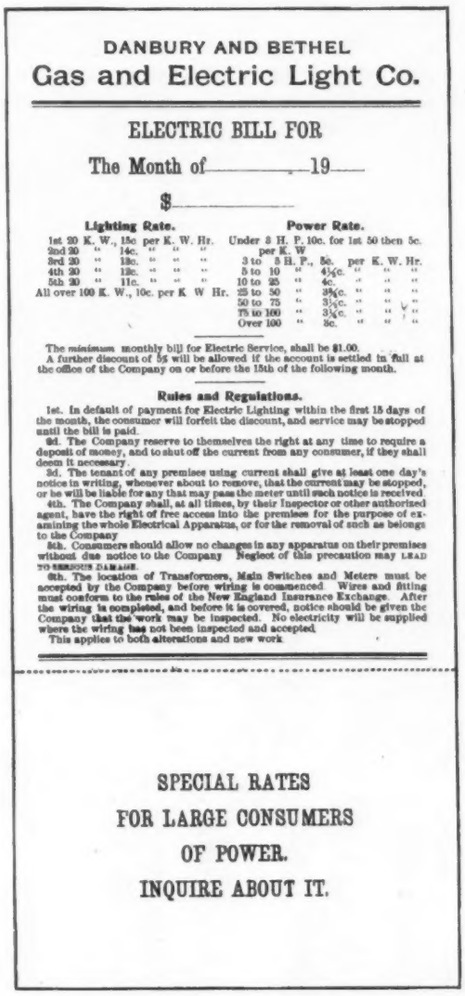
The rate for energy for lamps ranges from 15 cents to 10 cents per kw-hour, according to the quantity used, as will be seen by reference to Fig. 3. A consumer's bill for a consumption of 218 kw-hours, amounting to $24.80, is computed as follows:

20	kw-hours	at	15	cents	$3.00	
20	"	"	14	"	2.80	
20	"	"	13	"	2.60	
20	"	"	12	"	2.40	
20	"	"	11	"	2.20	
					$13.00	
118	kw-hours	at	10	cents	11.80	
						$24.80

The first 100 kw-hours thus cost $13.00, the remaining 118 kw-hours being sold at 10 cents per kw-hour net. Energy for sign lamps is sold at 5 cents per kw-hour net; this low rate is a special one to encourage this form of lighting.

Energy rates for motors range from 10 cents to 3 cents per kw-hour. Thus a motor installation of six hp would get energy at 4½ cents per kw-hour, while a 60-hp consumer would get a 3½-cent rate. There is a minimum charge on all installations of $1 per month. A discount of five per cent is allowed on all bills paid on or before the 15th of the month following the one for which it was rendered.

Mr. C. R. Hodgson, in speaking of the amount and character


DANBURY AND BETHEL

Gas and Electric Light Co.

ELECTRIC BILL FOR

The Month of ..... 19....

$.....

Lighting Rate.

1st 20 K. W., 15c per K. W. Hr.
2nd 20 " 14c. " " "
3rd 20 " 13c. " " "
4th 20 " 12c. " " "
5th 20 " 11c. " " "
All over 100 K. W., 10c. per K W Hr.

Power Rate.

Under 3 H. P. 10c. for 1st 50 then 5c. per K. W
3 to 5 H. P., 8c. per K. W. Hr.
5 to 10 " 4½c. " " "
10 to 25 " 4c. " " "
25 to 50 " 3½c. " " "
50 to 75 " 3¼c. " " "
75 to 100 " 3¼c. " " "
Over 100 " 3c. " " "

The *minimum* monthly bill for Electric Service, shall be $1.00.
A further discount of 5% will be allowed if the account is settled in full at the office of the Company on or before the 15th of the following month.

Rules and Regulations.

1st. In default of payment for Electric Lighting within the first 15 days of the month, the consumer will forfeit the discount, and service may be stopped until the bill is paid.

2d. The Company reserve to themselves the right at any time to require a deposit of money, and to shut off the current from any consumer, if they shall deem it necessary.

3d. The tenant of any premises using current shall give at least one day's notice in writing, whenever about to remove, that the current may be stopped, or he will be liable for any that may pass the meter until such notice is received.

4th. The Company shall, at all times, by their Inspector or other authorized agent, have the right of free access into the premises for the purpose of examining the whole Electrical Apparatus, or for the removal of such as belongs to the Company.

5th. Consumers should allow no changes in any apparatus on their premises without due notice to the Company. Neglect of this precaution may LEAD TO SERIOUS DAMAGE.

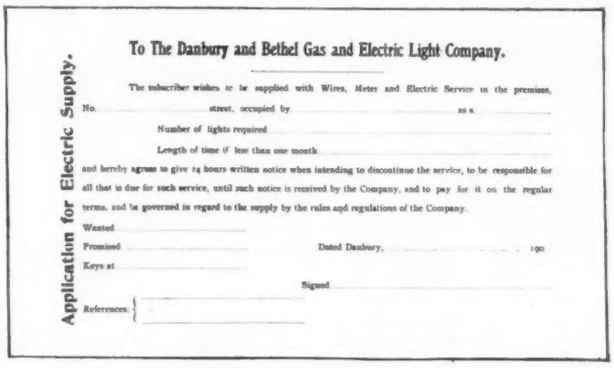
6th. The location of Transformers, Main Switches and Meters must be accepted by the Company before wiring is commenced. Wires and fitting must conform to the rules of the New England Insurance Exchange. After the wiring is completed, and before it is covered, notice should be given the Company that the work may be inspected. No electricity will be supplied where the wiring has not been inspected and accepted.

This applies to both alterations and new work.

SPECIAL RATES
FOR LARGE CONSUMERS
OF POWER.
INQUIRE ABOUT IT.

FIG. 3.—REVERSE SIDE OF ELECTRICITY BILL.

of the new business in Danbury, said that the motor business is the greatest revenue producer. "Some years ago we began to interest the hat factories of our city in the use of individual motors; it was some time before we made any headway along this line, but after one installation was in operation and the


Application for Electric Supply.

To The Danbury and Bethel Gas and Electric Light Company.

The subscriber wishes to be supplied with Wires, Meter and Electric Service in the premises, No. ..... street, occupied by ..... as a .....

Number of lights required .....

Length of time if less than one month .....

and hereby agrees to give 24 hours written notice when intending to discontinue the service, to be responsible for all that is due for such service, until such notice is received by the Company, and to pay for it on the regular terms, and be governed in regard to the supply by the rules and regulations of the Company.

Wanted .....

Promised ..... Dated Danbury, ... 190

Keys at .....

Signed .....

References: .....

FIG. 4.—APPLICATION BLANK.

results showed that electric motors reduced production costs, it was not long before the other factories were making inquiries. To-day nearly every factory in Danbury uses our energy to some extent. The sizes of the motors vary, the largest one connected

being 30 hp, which drives a coal hoist for the New Haven Railroad. This business reached such proportions that the station became overloaded and we had to stop taking on new business while awaiting the enlargement of the plant. A good deal of persistent and continuous work was required to obtain this business even after we had got started, and good, straight-from-the-shoulder talks with the consumer did more toward landing him than newspaper advertising or circular letters.

"In our lighting business we have had to contend against the condition that our city population is composed mostly of factory hands, but we have nevertheless done quite a little residence lighting. Along the main shopping street the stores have all been wired up and present a well-lighted appearance during the two evenings a week when they are open. The outside and window lighting is done on the outline plan and we have considerable of it in Danbury. The sign proposition has not been pushed in Danbury and what signs there are have been erected by the consumers; we have, however, encouraged this class of business with a 5-cent rate. The heating load is small at present. There are about 100 flat irons, a few curling irons and some heating pads in use."

In regard to advertising Mr. Hodgson said that while he believed in it, not much had been done along that line in the past owing to the limited capacity of the station. He has done some newspaper advertising and gotten up a booklet which describes the electric service and its varied uses.

There has been considerable active soliciting done for new business by Mr. Hodgson, while the employees have always been on the outlook and any prospects reported by them have been followed up by the superintendent. Incandescent lamps are renewed free of charge by the company. The bookkeeping is all done by one set of bookkeepers for both gas and electric service. The ledgers used are the loose-leaf style.

The present capitalization of the company is $200,000 and bonds have been issued for $150,000. The officials and heads of departments are: President, Mr. C. H. Merritt; secretary and general superintendent, Mr. G. E. Cowperthwaite; treasurer, Mr. A. N. Wildman; electrical superintendent, Mr. C. R. Hodgson; assistant superintendent, Mr. G. E. Stubbs; chief engineer, Mr. A. N. Fillow.

The Brooklyn Edison Company's Model Apartment and Its Attributable Results.

The model apartment exhibit of the Edison Electric Illuminating Company of Brooklyn at the recent electrical show in Madison Square Garden, New York, attracted widespread attention and comment, so that a brief statement as to the method of arranging for and conducting this example of spectacular and effective publicity will doubtless be of interest to central-station men throughout the country.

When the model apartment was decided upon as an exhibit, it was determined to furnish the rooms in as complete and artistic a manner as possible and to equip the apartment with every electrical appliance practicable for household use. At the same time the item of expense was to be kept down to the lowest possible figure consistent to the adequate carrying out of the conception; due regard being given to the fact often lost sight of, that under certain conditions economy is the wildest extravagance.

FIG. I.—GENERAL VIEW OF MODEL APARTMENT SHOWING ALSO A PORTION OF THE IMMENSE SIGN.

The furnishing and decorating of the apartment was planned between the advertising department of the Edison Company and the art and furniture departments of one of Brooklyn's largest department stores, which latter company was glad to supply, without charge, the furniture, rugs and general fittings of the apartment for the sake of the advertising obtained thereby. This scheme of cooperation worked out nicely in more ways than one. It was thus possible to secure an outfit of the most expensive and up-to-date character that otherwise would be out of consideration for a temporary exhibit of this nature. Rugs valued at $500 each for instance, were placed on the floors, and pictures many times this value were hung on the walls. Moreover the Edison Company secured the benefit of the department store's advertising of the model apartment, which advertising was done on a large scale. The Edison Company paid for the wall hangings, window draperies and all material and utensils that could not be returned in the same condition as received. The general result was harmonious and striking.

The majority of the electrical apparatus was also secured on a cooperative basis. The refrigerating machinery, clothes

washing and ringing machine, electric water heater, dish-washing machine, vacuum cleaner, electric piano, sewing machine, etc., were supplied by the manufacturers of the apparatus and the ordinary heating and cooking appliances were taken from stock.

The illumination of the apartment was planned by Mr. Lansingh, whose company also supplied the glassware and original sketches of suitable fixtures. All the concerns supplying features of the exhibit were given credit for the same, not only on placards conspicuously posted, but also in printed matter distributed to the crowd attending the exhibition.

FIG. 2.—BEDROOM.

The publicity work in connection with the show was begun about 10 days before the opening day. The Brooklyn newspapers were requested to send representatives to the office of the Edison Company and these were told of the wonders of the coming electrical show. There is in connection with such an event, a very real and powerful news interest, which if properly presented to newspaper men results in a great deal of free and valuable publicity. Advertising was not issued until the day before the show opened and then quarter-page advertisements were inserted. Prior to this, however, columns of news had been printed in the newspapers without charge.

FIG. 3.—REFRIGERATING ROOM.

On the opening evening Mr. Seelman of the Edison Company entertained the Brooklyn newspaper men at dinner and accompanied them from the hotel to the show. This resulted in more columns of news publicity the next day. During the show the newspapers were supplied each day with matter from the Edison Company's office detailing interesting features connected with the model apartment. This information was supplemented with photographs, many of which are shown herewith. The amount expended by the Edison Company for newspaper advertising was about $1,500, while $25,000 would be a conservative estimate of the value of the publicity secured.

In addition to newspaper publicity, the company mailed to each of its customers and to many thousand prospective customers, a well-worded letter describing briefly the show and the company's exhibit and offering to those requesting them two tickets of admission. To this letter about 75 per cent of the recipients replied. The tickets mailed to customers and others who responded were enclosed with another letter requesting the persons favored with tickets to register at the Brooklyn Edison booth. This letter also enumerated different prizes which were to be distributed among about 50 persons registering; each person so doing receiving a number.

FIG. 4.—DINING ROOM.

Only two tickets were allowed in each case. As a consequence the box-office receipts at the Garden were much higher than expected; in fact the publicity methods brought such immense crowds to the show that it was necessary on several occasions to close the doors for from one-half hour to an hour and a half to prevent possible accidents from overcrowding.

FIG. 5.—DRAWING ROOM.

Ten well-instructed women demonstrators were constantly in attendance at the model apartment. Each of these was supplied by the company with two tastefully designed pink

dresses so as to obtain a uniform effect. The solicitors and other members of the contract department were also in constant attendance as per schedules framed in advance. While no effort was made to sell appliances, more than 150 were actually sold during the show. The exhibit certainly fulfilled its purpose in educating thousands of people to the household possibilities of an electric service, besides giving the Edison Company a great deal of valuable advertising it could not have otherwise secured.

The entire cost to the Edison Electric Illuminating Company of Brooklyn for its exhibit was in the neighborhood of $10,000. The number of persons registered at the company's booth was 14,190. More could have registered, but the crowd at some times was so dense that it was necessary to desist registering in order to avoid congestion.

Many plans have been formed by the company and some are already in operation, to secure the largest amount of business from those represented in the registration, and so to reap the utmost benefit from its expenditure in connection with the show. All those registered who are off the lines of the company are for the present eliminated from consideration. The rest are divided into two classes—customers and non-customers. To the former by advertising and personal solicitation an active

FIG. 6.—GENERAL OFFICE.

campaign for the installation of electrical appliances other than for illumination will be carried on. To a limited list of such customers who can afford such apparatus, the question of electrical refrigeration, sweeping, dish washing, silver polishing, etc., will be brought home; while to a much larger list will be addressed a campaign for the introduction of washing, ironing, cooking and heating appliances.

Special solicitors have been engaged to do night work in connection with the non-customers along the lines. Letters making appointments for these solicitors to call will be sent out in advance and each registrar will be canvassed while the impression made by the exhibit at the electrical show is fresh in mind. In this way it is hoped to secure the wiring of a great many residences. The Edison Company will agree to pay for the wiring contracted for by any responsible householder, receiving payments therefor in monthly installments covering a period of one year. Before this canvass was started a number of requests by mail and by telephone to supply estimates for wiring of residences whose owners were impressed with the value of an electric service by the model apartment at the show, was received. It is hoped in the ways outlined above, and by other methods now being planned, to secure an amount of business from this advertising expenditure that will repay the company over and over again, and present indications are that this hope will be amply realized.

A detailed description of the model apartment, and also of the immense electric sign over it, was published in the first issue of October.

The Free Wiring of 1200 Residences at Pueblo.

At the Colorado Electric Light, Power & Railway Association Convention at Denver in September, Mr. J. F. Vail, general manager of the Pueblo & Suburban Traction & Lighting Company, mentioned the fact that his company had wired free 1200 residences in Pueblo for the sake of getting these customers on the company's lines. As this appeared to be a rather radical move, we have secured from Mr. Vail further information on the reasons for doing this free wiring, its cost and the returns obtained from it.

The condition with which the company was confronted was that in a town with about 5000 dwellings only 2000 were electrically lighted. Efforts to get additional residence business gave very discouraging results. Many of the houses were rented, and while the occupants said they would be glad to use electricity if they could get it, they would not pay the cost of wiring, and the landlords would not pay for wiring because they argued that the house would not rent for any more than before. Accordingly, it was decided that it would be better to wire a lot of these houses free and get them on the lines as paying customers immediately than to spend an equal amount of money distributed over several years to get a portion of them by solicitation. Of the 1200 houses wired, all were on the company's secondary circuits. The majority were rented houses, and most of them were not piped for gas. The two regular solicitors whom the company keeps in the residence districts were given the work of taking orders for free wiring. The free wiring offer was not advertised and was announced by solicitors as open only for a limited time. The company wired the houses and installed drop-cords free. The customer paid for the lamps and for any fixtures he might want. An extra charge was also made for wiring a porch lamp with a switch. The company employed 25 wiremen, most of whom were boys learning the business, working under competent supervision and drawing about $40 per month. The wiring was begun in April, 1906, and continued to February, 1907. The cost of wiring during the first part of this period was less than during the latter part, because of city ordinances which went into effect in June, which made the requirements more rigid and increased the cost.

The cost of wiring the first 348 houses was $7.64 per house. In these houses there were 2387 drop lamps, making the cost $1.11 per lamp, and the average number of drop lamps per house about seven. The second set of 116 houses wired under the more rigid requirements costs $11.06 per house with 786 drop lamps at $1.60, the number of lamps per house being about seven. The cost for 532 houses was $57.66, being about $10.85 per house. In this figure is included the time spent by the solicitors on this class of business, which amounted to about 10 per cent of the total cost, and a further 10 per cent was added to the cost shown on the books to provide for the use of teams, storeroom expense, etc. The actual cost of wiring came below the company's preliminary estimates, and the revenue which these customers have brought in amounts to more than that estimated.

It was thought before the work was begun that it would pay to do it if a revenue of $1.50 per month per customer could be secured. There is a minimum bill of $1. Mr. Vail states that as a matter of fact these 1200 customers have increased the company's revenue an average of $3,000 per month, or $36,000 per year. This seemed to be a rather high figure for such a class of houses. However, Pueblo is a railroad and manufacturing town, and the class of people who live in small, rented houses of the kind wired are inclined to be extravagant users of any commodity as long as they have money. While the proposition appears as a rather startling and radical one at first glance, when the facts are investigated it is seen that with the cheap class of wiring done, the gross revenue from this class of business will, in any event, more than pay for the wiring the first year; and under conditions as favorable as those in Pueblo, within much less time than that.

Fighting the Isolated Plant in Haverhill, Mass.

One of the most compact folders recently issued in central-station service in the campaign against isolated plants is a 3⅛ in. x 6 in. leaflet prepared by the Haverhill (Mass.) Electric Company for distribution among its customers and the general public. One page of the folder is reproduced herewith and needs no explanation, though emphasis might be laid upon the blank spaces to the right of the list of 21 expense items which make up the total cost of operating an isolated plant. It is safe to say that many a "prospect" has never realized the

Items chargeable monthly to the cost of operating ISOLATED PLANTS.

OPERATING EXPENSES.				
1. Superintendence,				
2. Wages.—Engineers and Engine Attendance,				
3. Wages,—Firemen and Coal Passers,				
4. Fuel,				
5. Cost of Removing Ashes,				
6. Water for Boiler,				
7. Repairs to Engines,				
8. Repairs to Boilers,				
9. Repairs to Dynamos,				
10. Repairs to Belts,				
11. Repairs to Steam Elevators,				
12. Repairs to Hydraulic Elevators,				
13. Repairs to Pumps and Miscellaneous Machinery,				
14. Miscellaneous Expense, Oil, Waste, Packing, Etc.,				
15. Insurance—Fire and Boiler,				
TOTAL OPERATING EXPENSES.				
FIXED CHARGES.				
16. Interest on Plant Investment, 5%,				
17. Depreciation on Plant Investment, 7%,				
18. Rental Value of Space Occupied by Plant,				
19. Decreased Rental Value of Space made less desirable by Heat of Plant in Summer,				
20. Taxes on Plant,				
21. Risk of Damage to Employees and Public through Accident,				
Cost for Maintaining Plant, per Month,				

Horse Power of Plant,.....

Cost Per Horse Power Per Month, $.....

THIS IS FOR DAY SERVICE ONLY.

BLANK FORM FOR EXPENSE ITEMS.

number of items which enter the case; the usual plan being to figure the fuel and supply cost, with a possible repair and wages allowance in case it is clear that the attendants are not needed for other than plant duties a large part of the time. The blank spaces invite every business man to put down the cost of the various items in the operation of his isolated plant for two definite periods; to compare them with what he though. it was costing him, and then to send the estimate to the Haverhill Company to see if a lower charge cannot be made.

An Interesting Lighting Contract Experience.

An interesting account was given in the ELECTRICAL WORLD of Nov. 18, 1905, of the use made at Maryville, Mo., of a special daily newspaper, by the Maryville Electric Light & Power Company, in its struggle for a franchise and lighting contract. This newspaper was used as a medium of appealing to the public, and was issued outright by the company with a frank avowal of its purpose. Mr. J. C. Donnell, the energetic secretary and manager, now furnishes us the sequel as follows:

I wish to give you the final result, which developed at an election Sept. 2, 1907. This election gave us a new franchise for 20 years and authorized the city council to enter into a very satisfactory contract for lighting the streets for a period of five years. Our contest, for two years, has been very vigorously waged and at no time has the public interest in our city or the efforts of our company relaxed, from the first battle until the final issue, which was passed upon by the people at the last election.

During this time we were compelled to issue seven more issues of our paper, of which we changed the name on Nov. 9, 1905, from the "Gas News" to "The Searchlight" and issued one number on that date; then from March 30, to April 2, we issued three numbers; from Oct. 6 to Oct. 18, 1906, we issued three numbers with a supplement. During this time we met and defeated another gas franchise, and a municipal ownership proposition, and lacked only 17 votes of carrying a renewal of our franchise and a 10-year contract by a necessary two-thirds vote. We have had two city elections at which the light question was the paramount issue, not by our choice but by the choice of the people.

The city council was lighting our streets with gasoline lamps when they were not in darkness, under a contract unauthorized by law, and then the whole city council including the mayor resigned. The citizens elected a new city government last April, which was favorable to resubmitting our proposition to the people. This was done on Sept. 2, and resulted as follows: For granting us a 20-year franchise, 101 votes more than two-thirds of all votes cast, a majority only being necessary; for authorizing the city council to enter into the contract 90 votes more than two-thirds of all votes cast, a two-thirds vote being necessary; the total vote being 702.

It is unnecessary to state that I feel greatly relieved and complimented in the results, considering the efforts we made in defending a public service corporation, in the face of an antagonistic press, the popular craze that is going over the country, of condemning all private corporations for everything they have done in the past and the extreme effort being made to regulate such corporations by legislators and city governments. All this makes our victory, which received such an overwhelming indorsement from our people, the more gratifying.

Convenient Tests for Central Station Operators.

BY W. M. HOLLIS.

Without laying claim to originality or novelty of treatment, the writer is of the opinion that the following enumeration and descriptions of convenient tests for central station operators will be of interest to those directly concerned in such work. There are times when tests are necessary, and if these can be made with ordinary instruments and apparatus by the station man, this is to his credit.

Several methods will first be shown for obtaining alternating current of various voltages from the regular station lines. Fig. 1 shows a bundle of iron wires serving the same purpose as the core of a transformer; and wound upon this bundle of iron wires are two coils *A* and *B*, each containing the same number of wires, similar ends being connected to the same line wire. The station wires have a potential difference of 1000 volts between them. On the same core is wound another coil of wire, *C*, containing a lesser number of turns of wire than the coils *A* and *B*, and serving the purpose of the secondary winding of a transformer. When the similar ends of the coils *A* and *B* are connected to the alternating-current mains, a flux is set up in the iron core and the counter e. m. f. induced in the primary winding is directly proportional to the number of turns. The flux set up by the magnetizing current in the primary cuts the turns of wire in the secondary coil, *C*, and the voltage generated in the closed secondary circuit will be approximately proportional to the number of turns of wire in the coil. As connected, the effect of the coils is additive. If now the connections of one of the primary coils be reversed, the direction of the lines of force will be reversed and both coils having the same number of turns, a neutral effect results and no secondary e. m. f. will be generated in the coil *C*.

In order to show the practical application of the above, con-

sider the case of a transformer with two primary and two secondary coils, the ends of which are brought out to a suitable connecting board on the casing of the transformer. The connections should be arranged so that various multiple and series combinations can be easily made.

In Fig. 2 a single transformer is shown with the primary coils connected in multiple and the secondary coils connected in series; the ratio of transformation being 5 to 2. In Fig.

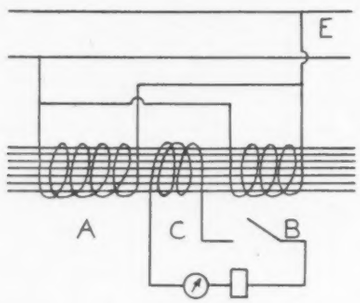
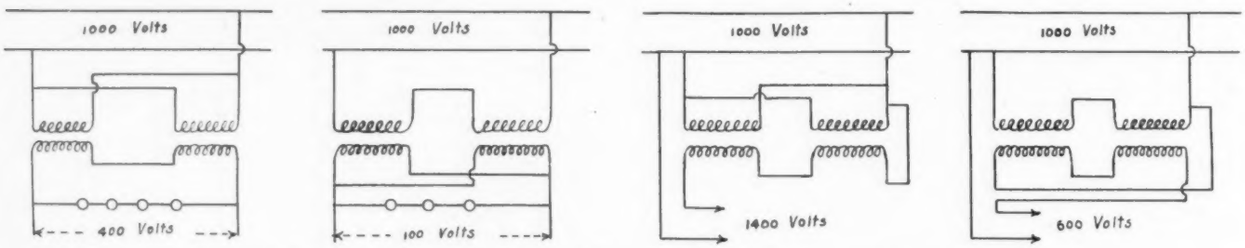


FIG. 1.—DIAGRAM OF TRANSFORMER CONNECTIONS.

3, the primary coils are shown connected in series and the secondary coils connected in multiple; the ratio of transformation being 10 to 1. If the pairs of coils are connected both in series and both in multiple the ratio would be 5 to 1; so that with an e. m. f. of 1000 volts on the primary wires a secondary voltage of 100, 200 or 400 may be obtained. In practice, however, most transformers are adapted for only two changes, as, for instance, for 100 and 200 volts.

In Figs. 4 and 5 connections are shown whereby various intermediate voltages may be obtained for use in various tests. It should, of course, be borne in mind that in the arrangements immediately following the voltages are those of the primary side and the secondary current due to the secondary e. m. f. generated depends on the resistance in the secondary circuit and on the primary input.

When a voltage higher than the line voltage is desired, the transformer is arranged for "boosting," and when a lower



FIGS. 2, 3, 4 AND 5.—TRANSFORMER CONNECTIONS FOR OBTAINING VARIOUS VOLTAGES.

voltage is desired the connections are arranged for "bucking." In this latter case the secondary coils contain a less number of turns than the primary coils and are connected so that the voltages added to or subtracted from the line are only a part of the same and are not completely neutralized. If the secondary lead to be connected to the line wire for boosting, for instance, is not known, after connecting the secondary coils in series, connect either outside lead at random and then measure the voltage of the line and then that between the unconnected secondary lead and the other wire by means of a regular instrument transformer with a voltmeter in the secondary circuit.

If the voltage is less than that of the line, the primary circuit should be opened and the outer secondary leads reversed. Fig. 5 shows connections for obtaining a reduced voltage, the arrangement being opposite to that shown in Fig. 4. With the transformer shown in Figs. 2 and 3, voltages may be obtained from 800 to 1200, or, in some instances, from 600 to 1400.

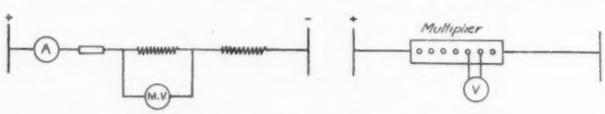
In order to make a single test or a series of widely different tests upon lines, insulation, apparatus, etc., a number of instruments are ordinarily needed, especially where simultaneous readings are essential. It is the purpose here to consider some of the uses to which a voltmeter may be adapted. For the purpose of illustration consider a direct-current voltmeter with a 150-750 volt scale. For convenience, assume that the series resistance for the 750-volt scale is about 75,000 ohms, and that for the 150-volt scale about 15,000 ohms. As a matter of fact, the deflection of the needle is directly dependent upon the current flowing in the movable coil. With a full-scale deflection, the current flowing is equal to 750 ÷ 75,000, or 0.01 ampere.

With a calibrating coil having a resistance of about 75 ohms and with a current of 0.01 ampere flowing, the applied e. m. f. would be 0.75 volt. By using an additional resistance of suitable value in series with the other, the instrument may be used as a millivoltmeter. For a full-scale deflection of 1.5 volts with a current of 0.01 ampere, this resistance should be 150 ohms. The instrument may, therefore, be used for measuring voltages as high as 750, and may be used with a full-scale deflection of 150 volts or 1.5 volts. If in addition it is desired to measure currents by means of a metal shunt in series with the line the voltmeter may be used for that purpose. In every case where current flows through a resistance there is a definite drop of potential equal to the product of the resistance and current.

Suppose it is desired to measure currents up to 150 amperes. With a current of 0.01 ampere flowing through the instrument a full scale deflection of 150 is obtained in the voltmeter. Therefore, the shunt should have such resistance that with 150 amperes passing through it and the connections to the instrument, the drop across the terminals should give a full scale reading. Using the 1.5 volt scale, the resistance of the shunt should be such that there will be a drop of 1.5 volts when the shunt passes 150 amperes. Therefore, the resistance of the shunt and connections should be 1.5 ÷ 150, or 0.01 ohm. Skill will, of course, be required to make such an instrument.

A convenient method of ascertaining resistances rapidly where accuracy is not desired is by comparison with some known resistance. For this purpose the millivoltmeter readily adapts itself. The known resistance is placed in series with the voltmeter and the resistor whose resistance is to be ascertained. By means of a resistor of adjustable resistance, such as a water rheostat, a convenient current may be obtained to give a fair scale deflection. By maintaining the current constant, the voltage is measured across the known resistance and then across the unknown resistance. The resistances are directly proportional to the deflections, so that the value of the unknown resistance is readily ascertained by proportion.

If the only instrument at hand has a considerably less range than desirable, lamp banks may be employed for obtaining



FIGS. 6 AND 7.—CONNECTIONS FOR TESTING.

rough values by measuring between points within the range of the instruments and adding the results. If a large number of such readings is likely to be taken from time to time, a multiplier may be used. See Fig. 7. The resistances in this case are equal between binding posts, and, as used here, the multiplier allows a voltage five times as large as the instrument can measure directly to be ascertained.

Wiring with Iron Conduit.

BY LOUIS J. AUERBACHER.

The installation of electric wires in conduit is recognized as exemplifying the best practice known in the art. There are two kinds of conduit on the market—the lined and the unlined. The latter is used almost exclusively and is either galvanized or enameled with some insulating varnish. For out-door use or installations in damp places, and for work imbedded in cement, the galvanized conduit should be used. The code requirements permit the use of single-braided wire in lined conduit, but call for double-braided rubber-covered wire in the unlined conduit. Inasmuch as the lined conduit is fast becoming obsolete, the author in this article will treat only of the regular unlined type.

TABLE I.—CONDUIT FOR VARIOUS WIRE SIZES.

No. B. S.	Circ. Mils.	Ampere.		Sizes of Pipe.		
		Rubber.	W. Pr'f.	1 Wire.	2 Wire.	3 Wire.
18	1,020	3	5	½″	½″	½″
16	2,583	6	8	½	½	½
14	4,107	12	16	½	½	¾
12	6,530	17	23	½	¾	¾
10	10,380	24	32	½	¾	1
8	16,510	33	46	½	1	1
6	26,250	46	65	¾	1	1¼
5	33,100	54	77	¾	1¼	1¼
4	41,740	65	92	¾	1¼	1½
3	52,630	76	110	¾	1¼	1½
2	66,370	90	131	¾	1½	2
1	83,690	107	156	1	1½	2
0	105,500	127	185	1	2	2
2-0	133,100	150	220	1	2	2
3-0	167,800	177	262	1¼	2	2½
4-0	211,600	210	312	1¼	2	2½
	200,000	200	300	1¼	2	2½
	250,000	235	350	1½	2½	2½
	300,000	270	400	1½	2½	3
	350,000	300	450	1½	2½	3
	400,000	330	500	1½	3	3
	450,000	380	545	2	3	3½
	500,000	390	590	2	3	3½
	550,000	420	635	2	3½	4
	600,000	450	680	2	3½	4
	650,000	475	720	2	3½	4
	700,000	500	760	2	3½	4
	750,000	525	800	2	3½	4
	800,000	550	840	2	3½	4
	850,000	575	880	2½	4	4
	900,000	600	920	2½	4	4½
	950,000	625	960	2½	4	4½
	1,000,000	650	1000	2½	4	4½
	1,100,000	690	1080	2½	4	5
	1,200,000	730	1150	2½	4	5
	1,300,000	770	1220	2½	4½	5
	1,400,000	810	1290	3	4½	6
	1,500,000	850	1360	3	5	6
	1,600,000	890	1430	3	5	6
	1,700,000	930	1480	3	5	6
	1,800,000	970	1550	3	6	7
	1,900,000	1010	1610	3	6	7
	2,000,000	1050	1670	3	6	7

The use of iron conduit has resulted in standardizing various accessories and fittings, enabling the contractor to install a neat, safe and superior electrical installation without much trouble.

When laying out a conduit installation, the size of wire necessary for the various circuits should first be determined. Afterwards the necessary size of conduits to enclose the mains and feeders may be ascertained. The branch circuits are usually run in ½-in. conduit, since this is the smallest size permissible under the code rules, and since the branch circuits are usually of a size easily accommodated by a conduit of this dimension. It is usual to draw both wires of the circuit in the conduit regardless of whether the supply be alternating current or direct current. In the former case, the running of both wires of the circuit in the same conduit is mandatory, while in the latter case it is strongly recommended. Table I shows the sizes of conduit required for various sizes of wire. Allowance has been made in this table for easy pulling of the wires around three elbows, so that in straight short-line runs, conduit a size smaller than specified may be used. Table II gives the actual inside and outside diameters and also the weight of standard conduit. The outside diameters are given so that the necessary size of drill and bit may be readily ascertained for drilling holes in panels, pull-boxes, etc.

In laying out long runs, or runs requiring more than three elbows, a pull-box may be substituted for bends to advantage. The pull-box may be of iron or may be made of wood iron lined; the sheet-iron of the iron-lined pull-box should not be smaller than No. 12 gauge. Pull-boxes properly drilled should be made up and sent to the job, as workmen are liable to waste much time if required to make them on the spot. When running a number of large conduits together, an angle pull-box is preferable to elbows. Elbows, especially if they are large, are quite expensive, and one pull-box may easily displace two or more elbows. Fig. 1 shows a pull-box substituted for three elbows. Another advantage of the pull-box over the elbow is that a size smaller conduit can often be used, owing to the absence of the elbow.

Conduits should always be of such size that wires may be easily pulled in. One of the objects of the conduit system is to provide a substantial raceway for the conductors. The practice of pulling wires through a conduit by means of a block and fall is objectionable, and the underwriters should compile a table showing the smallest size of the conduit allowed for various sizes and groups of wires. It is evident that if wires are pulled in forcibly, the insulation becomes damaged and it is also next to impossible to pull them out again. This is especially true in very warm places, where if the conduit is too small and the lining softens because of the heat, the removal of the wires becomes very difficult indeed. In fireproof buildings, the conduit is run on the firebrick floors, the ends being bent so as to reach the outlet box, as shown in Fig. 2. There

TABLE II.—SIZES AND WEIGHTS OF CONDUIT.

Size Pipe.	Weight — 100′.	Diameter — .64.	
		Inside.	Outside.
½″	85 lbs.	39	54
¾″	112	52	1.4
1 ″	167	1.2	1.21
1¼″	224	1.24	1.43
1½″	268	1.38	1.58
2 ″	361	2.4	2.25
2½″	594	2.30	2.57
3 ″	754	3.2	3.32
3½″	900	3.34	4
4 ″	1066	4.4	4.32
		64ths.	64ths.

should be no burrs in the conduit and all joints should be well screwed together. It is generally necessary to rerun the threads of the conduit in order that the joints may be well and rapidly screwed together. In a large installation, this work should preferably be done on a threading machine.

There are many devices on the market for bending conduit,

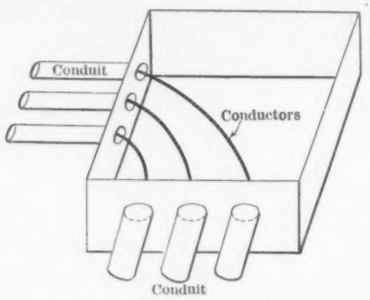


FIG. 1.—PULL BOX

but one of the chief disadvantages of these devices is that the conduit must be brought to them to be bent. For this reason, a very simple, efficient, and home-made device known as the "hickey" is extensively used. The hickey illustrated in the upper part of Fig. 3 is made of an ordinary T pipe-fitting, and a piece of pipe. The lower hickey is a commercial form. By means of either of these, the conduit may be bent while being laid. For bending large conduit, a heavy, substantial support, as shown in Fig. 4, is often used. This consists of two pieces of wood, bolted to a column or other support in the manner shown.

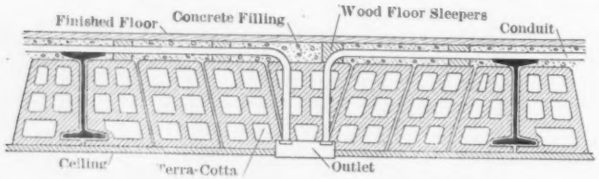


FIG. 2.—CONDUIT IN FIRE-PROOF FLOOR.

For fastening conduit to firebrick, ceilings or other plastered walls, toggle bolts are extensively used. In fastening conduit to a brick wall, expansion bolts and screws should be used. When running conduit on iron beams, girder hooks, fastened to wooden or iron supports may be used, or special girder clamps, of which there are a number on the market. Fig. 5 shows some forms of girder clamps for this work. In fastening

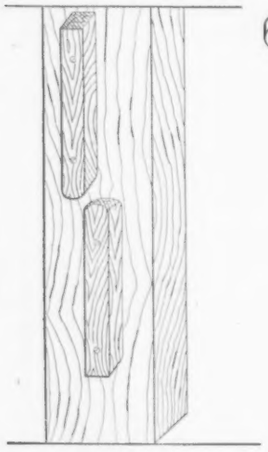


FIG. 4.—CONDUIT BENDER.

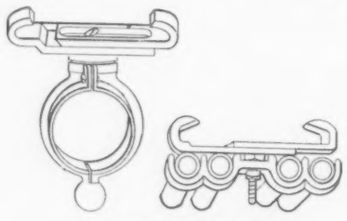


FIG. 5.—PIPE HANGERS.

conduit to wooden beams, the ordinary pipe-hook, staple or strap may be used, and in long, vertical runs, straps which securely grip the pipe are preferable.

A new class of buildings, made entirely of reinforced concrete, presents a new problem to the electrical contractor. This problem may best be solved by laying out the preliminary work when the building is being erected so as to avoid drilling of holes in the concrete as much as possible. If the wiring is to be concealed, the location of the outlets should be marked by a sheet-iron tube large enough to accommodate the conduit lines. This tube, properly plugged, may be set in the false work before the concrete is poured, as shown in Fig. 6. For risers a threaded piece of conduit of proper size should be put in the false work before the concrete is poured. This pipe

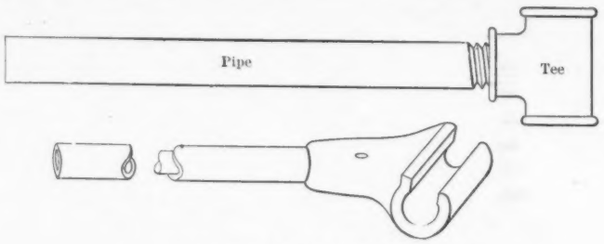
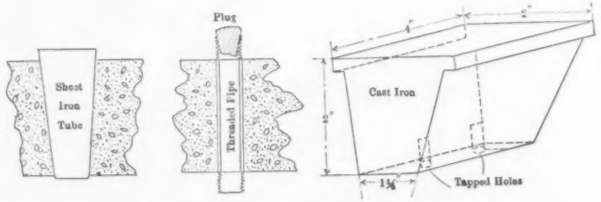


FIG. 3.—TWO FORMS OF HICKEY.

should have a running thread so that the conduit can be readily joined to it. See Fig. 7.

For open wiring on concrete ceilings, a series of cast-iron supports should be set in the mould. These supports, one of which is shown in Fig. 8, should be drilled and tapped, and when liberally used, form good supports for other piping as well. The supports should be inserted in the ceiling moulds at regular intervals in order to obtain the greatest flexibility



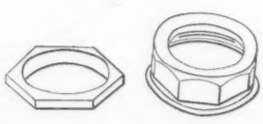
FIGS. 6, 7 AND 8.—DEVICES FOR REINFORCED CONCRETE BUILDINGS.

in installing the pipe lines. For use in connection with open-conduit wiring, outlet and switch boxes similar to those used in concealed work should be used. Figs. 9, 10 and 11 illustrate a number of these.

It is very important that the insulating quality of the wire used in conduit work should be the best. Very often condensation takes place in a conduit and the insulating material deteriorates. In such cases the importance of having conduits of ample size is apparent. In running circuits requiring No. 12 and No. 14 wire, duplex wires are usually used. No wires should be drawn in the conduit system until the finishing coat of plaster is in place. This is done in order to test all the conduit after all the other work in the building has been completed. If no obstructions are encountered when pulling through the wires, it indicates that the conduit system has suffered no damage.

Where conduit is used outdoors or in damp places, a lead-

FIGS. 9, 10 AND 11.—OUTLET AND SWITCH BOXES.



FIGS. 12 AND 13.—LOCK NUT AND BUSHING.

encased wire should preferably be used. Great care should be exercised in drawing in the lead cables so as not to puncture the casing.

In all conduit systems the fittings such as outlet and switch boxes should be iron or iron-lined. The selection of fittings and the method of installing them are very important from the

standpoint of cost. The fittings should be adapted for the purpose so that it will not be necessary for the wiremen to tinker with them. The iron outlet box should, for use in fireproof buildings, preferably be of stamped steel of the "knock-out" type. These boxes are made with a number of easily removable discs known as "knock-outs," any of which the wireman may knock out with a hammer, thereby giving him holes in any part of the box as may be required. Figs. 15, 16, 17 and 18 illustrate a number of outlet boxes of this type. Boxes used in concealed work in fireproof buildings are fastened to the conduit by means of a lock-nut and bushing, and wherever a conduit terminates, the bushing must be used. Figs. 12 and 13 illustrate the standard lock-nut and bushing for this purpose. All boxes should be set so that the edges are flush with the finishing coat of plaster.

Switch boxes for the use of switches and receptacles should

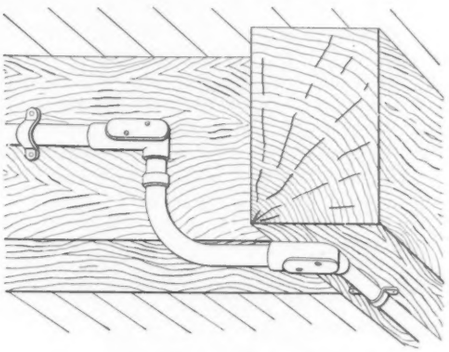
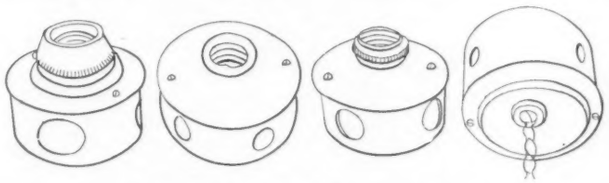


FIG. 14.—ELBOW FITTING.

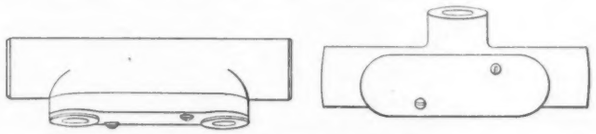
also be of the knock-out type, and securely fastened to the wall by means of toggle-bolts or expansion bolts.

To supply the demand for a neater-fitting, as well as a more substantial one, a new and distinctive line of outlet boxes, etc., covering the wide range of adaptability has recently made its appearance in the market. These fittings are made in a large variety, and while they would tend to complicate the already overburdened stock room, they are nevertheless a boon to the contractor. Fig. 19 illustrates an outlet fitting of this type which can be used to advantage for outlets between beams. As



FIGS. 15, 16, 17 AND 18.—OUTLET BOXES

the fitting screws rigidly to the conduit, no support is necessary. In buildings of mill construction this is a decided advantage. The cover of the fitting is interchangeable and either a drop-lamp fixture or a stem may be used. Fig. 21 illustrates an end fitting where an outlet also terminates the circuit. The end fitting used, as shown, requires no support, and besides saving time and money, presents a neat appearance.



FIGS. 19 AND 20.—CONVENIENT FITTINGS.

Fig. 20 shows a T-fitting applicable for any branch work and also as a pull-box. Where it is desirable to continue open wiring from conduits, or the character of the wiring requires the conductors to be brought over from the conduit, as for instance in wiring an arc lamp, a good combination of these fittings, as shown in Fig. 24, may be employed. The wires brought out from the conduit system are 2½ ins. apart, and thus a neat and safe job is secured. Fig. 14 shows a good elbow fitting, serving also as a pull-box, which is especially useful for wiring on wooden columns or making complicated turns, since it does away with awkward elbow work. For wiring outlets in groups on outdoor awnings, a receptacle like that shown in Fig. 22 answers very well. It is advisable to make up these outdoor circuits in the shop so that all that remains for the wiremen to do is to screw the lines in place. A good feature of this line

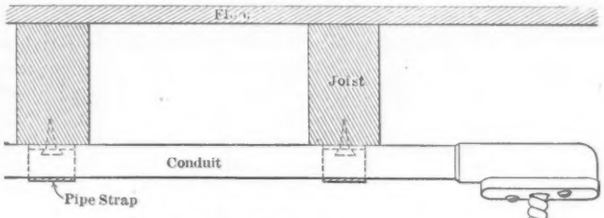


FIG. 21.—END FITTING.

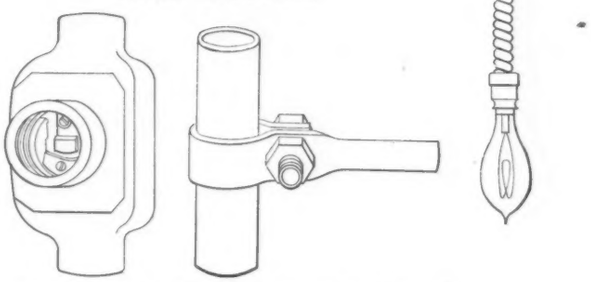


FIG. 22.—RECEPTACLE FOR OUTDOOR WORK.

FIG. 23.—GROUND CLAMP.

of fittings is that they make good electrical contact with the conduit. Such is not the case with the ordinary outlet boxes, and since all conduit systems are required to be grounded, this is important. Fig. 23 shows a type of ground clamp applicable for conduit work. The conduit should be scraped clean before the clamp is applied. Another clamp of this description should be fastened to a water main and the two joined together with a copper wire sweated in the lugs.

For terminating a conduit line outside a building, a fitting designed to prevent the ingress of moisture should be used. Fig. 25 illustrates a good device for this purpose, one ad-

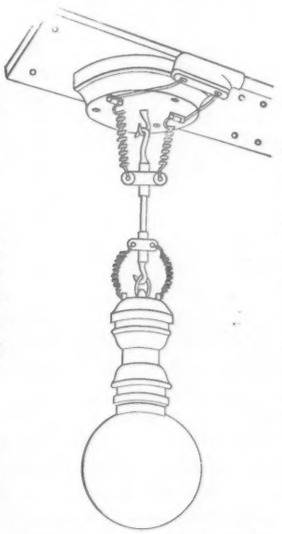


FIG. 24.—ARC-LAMP WIRING.

FIG. 25.—SERVICE ENTRANCE.

vantage of which is that the porcelain cover spreads the wires the proper distance apart.

Where conduit terminates in a switch or panel box, the lining or casing of the panels must be of iron, and the conduits should be securely fastened to it so as to make a good electrical contact. The ends of the conduit, of course, must be properly bushed.

The Right to a Patent as Between Employer and Employee.

By John Edson Brady.

To determine which of two or more parties is rightfully entitled to a patent is a task frequently placed upon the courts of the United States. No fixed rule can be laid down which will cover all, or even a majority of the cases, each case being necessarily decided upon the facts presented. The respective rights of the parties are in many cases difficult of determination, but in no case is the question presented more complicated than when the parties bear to each other the ordinary relationship of employer and employee. The rule that the "first and original inventor" is entitled to a patent always holds true. However, it is obvious that a prospective inventor may dispose beforehand of his rights to a patent upon any device or process which he may invent, and in such case, not the original inventor, but his assignee is entitled to the patent. Thus, an employee may agree to devote his inventive faculties to the service of his employer, and thus confer upon him all the fruits of his inventive skill during the period covered by his contract. This, in effect, is an assignment in advance by the employee of any inventions which he may make during the term of his employment. An agreement of this kind, however, must be unequivocal, and cannot be implied from a general bargain for his time, skill and labor, nor is it proved conclusively by the fact that the experiments resulting in the invention were made at the request and expense of the employers.

But it is in cases where the parties have made no contract other than the ordinary contract of employment that the rights of the parties must often become most intricately involved. There is no doubt that the mere fact that a person is in the employ of another does not preclude him from making improvements in the machines with which he is connected, and obtaining patents therefor, as his individual property, and that in such case the employer would have no more right to seize upon and appropriate such property than if the relation of employer and employee had never existed between the parties. On the other hand, it is equally clear that, if the patentee be employed to invent or devise certain improvements, the patents which he obtains on such improvements belong to the employer, since in making the improvements he is merely doing what he was hired to do. Gill vs. United States, 160 U. S. 426.

In the case of Deane vs. Hodge, 35 Minn. 146, it appeared that the director of a corporation engaged in the business of manufacturing harvesting machines invented an improvement, which was immediately taken up by the company and placed on every harvester turned out. It was advertised in the circulars sent out and materially increased the profits of the business, while the additional expense of adding it to each machine was trifling. There was no express agreement between the company and the inventor, and it was held that the inventor owned the right to the patent and might recover a reasonable compensation from the company for the use it had made of his invention. Where a party has availed himself of the services or used valuable property of another, such as an invention, the law, in the interest of justice, will imply an agrement to pay a reasonable compensation, unless the circumstances attending such use are of such a character as to justify the conclusion that it was the understanding of the parties that the use was to be gratuitous. It is true that a man has a right to render a voluntary service, or give a right to use his property to another, without remuneration, and if he does, he cannot afterwards recover for such services or use of his property; but it does not follow that his mere neglect to demand a specific agreement for compensation, or to forbid the use of his property, necessarily deprives him of his right to a reasonable remuneration. The circumstances may be such as to show that the understanding of the parties was that the services rendered, or the use of the property, was to be without compensation; and in such case, the party cannot recover. Where the evidence fails to disclose an express agreement or understanding, the law may imply a contract from the circumstances or the acts of the parties; and where there is nothing from which a contrary intention or understanding is to be inferred, it is a just and reasonable presumption that he who has received the benefit of the services or property of another impliedly undertakes to pay for it.

In another case the plaintiff, while in the employ of the defendant railroad, invented a spark arrester, an automatic air brake and other improvements intended for use on railway rolling stock. The general manager of the road, upon being apprised of the inventions of the master mechanic, ordered a portion of the rolling stock to be equipped with them. After the inventor left the employ of the railroad he brought suit to recover damages from the company to compensate him for the use by the company of his patented improvements. It was held that inasmuch as none of the company's labor or material had entered into the discovery or perfection of the inventions, the company was not entitled to use the inventions merely because the inventor was in its employ, and the latter was allowed to recover the reasonable value of his patents to the company. The use of the patents by the railroad was compared to the taking of coal or any other commodity by the railroad. If the railroad, for instance, had run out of coal, and, knowing that its master mechanic was plentifully supplied therewith, had ordered him to bring down a thousand bushels for the use of the company, it was said by the court, "no one would claim that the master mechanic should not be paid for it, because he was an employee, and the coal was necessary to the proper carrying on of his department, even though nothing was said about pay." Fort Wayne, Cincinnati & Louisville Railroad Company vs. Haberkorn, 15 Ind. 479.

In 1876 an employee of a manufacturing corporation was instructed to devise and build an iron sulky plough which would retain the valuable features of the wooden plough, which had previously been made by the company, and would also have certain new features suggested by the president and other officers of the company. The employee accordingly went to work and constructed a sulky plough of wrought and malleable iron which met with the approval of the company's president. During all the time he was engaged in getting the new plough ready, the employee drew a salary from the corporation of $3,000 a year, and the men who did the manual part of the work were in the employ of and paid by the corporation. While the employee remained with the company he never made any claim of property in the new plough, and never claimed that he was entitled to a patent. But after his connection with the corporation ceased, and after the corporation had been engaged for many months, with his consent, in the manufacture of the ploughs the employee applied for and was granted patents covering certain parts of the plough. The corporation having in the meantime dissolved, its trustee brought action against the employee to compel him to convey to them the letters patent which he had obtained upon the plough. There was nothing in the contract of employment which gave the corporation any right to the patents on the plough, and it was held that the most that could be claimed for the company was a mere license to manufacture the ploughs, which right, being a mere personal one, was extinguished by the dissolution of the corporation. The right to a patent belonged to the employee. Hapgood vs. Hewitt, 119 U. S. 226.

There are many other cases in which, while the employee has been regarded as being the proper person to take out the patent, it has been held that the employer is entitled to use the subject of the patent. A draftsman, employed by the United States at the Frankford Arsenal in Pennsylvania, as master armorer, invented during the term of his service, a cartridge loading machine and several other devices, upon all of which he took out patents. These patents he assigned to various persons, but reserved in each instance the right of the government to use them. His engagement required him to perform manual labor and exercise mechanical skill in the service of the government, but did not require the exercise of inventive genius. After he left the service he brought an action against the government to recover the reasonable value of the use of his in-

ventions by the government. The case raised the question whether an employee paid by salary or wages, who devises an improved method of doing his work, using the property or labor of his employer to put his invention into practical form, and assenting to the use of such improvements by his employer, may, by taking out a patent upon such invention, recover a royalty or other compensation for such use. In a series of cases it has been held that this cannot be done. The inventor may not have intended to give the benefit of his discovery to the public and may have supposed that, by giving permission to a particular individual to construct for others the thing patented, he could not be presumed to have done so. But it is not a question of intention which is involved, but is rather one of legal inference, resulting from the conduct of the inventor. It was here held that the draftsman could not recover. "Clearly," said the court, "a patentee has no right, either in law or morals, to persuade or encourage officers of the government to adopt his inventions, and look on while they are being made use of year after year without objection or claim for compensation, and then to set up a large demand upon the ground that the government had impliedly promised to pay for their use. A patentee is bound to deal fairly with the government, and if he has a claim against it, to make such claim known openly and frankly and not endeavor silently to raise up a demand in his favor by entrapping its officers into making use of his inventions." Gill vs. United States, 160 U. S. 426. So, also, when one is in the employ of another in a certain line of work and devises an improved method of work or instrument for doing that work, and uses the property of his employer and the services of other employees to develop and put in practical form his invention, and explicitly assents to the use by his employer of such invention, a jury or court trying the facts is warranted in finding that he has so far recognized the obligations of service flowing from his employment and the benefits resulting from his use of the property and the assistance of the co-employees of his employer as to have given to such employer an irrevocable license to use the invention. Solomon vs. United States, 137 U. S. 342.

A person in the employ of a smelting company invented a new method of tapping and withdrawing molten metal from a smelting furnace. He took out a patent for it and permitted the company by which he was employed to use it without charge so long as he remained in its employ, which was about ten years. After that his employer continued to use it, and when the patent was about to expire the patentee filed a bill against the company, praying for injunctions, preliminary and perpetual, and for an accounting. On the trial, it appeared that the invention had been used for more than 17 years with the knowledge and assent of the patentee, and without any complaint on his part, except that the company had not paid royalties after he quitted its employment. It was held that the employee was not entitled to an injunction. Keyes vs. Eureka Consolidated Mining Company, 158 U. S. 150. In McClurg vs. Kingsland, 17 How. 202, the inventor, whose name was Harley, was employed by the defendants at their foundry in Pittsburg. In 1834, while he was so employed, Harley invented an improved roller as a result of which his wages were increased. Harley continued in his employment and some time after making the invention he suggested that his employers take out a patent and purchase his right, which they declined to do. He made no demand on them, however, for any compensation for using his improvement, nor did he give them any notice not to use it until a misunderstanding in regard to another subject arose and he left the foundry. It was held that the facts amounted to a "consent and allowance of such use" and gave the defendants a right to continue the use of the invention.

Many contracts of employment, in which it is contemplated that the employee will exercise his inventive skill for the benefit of his employer, are so framed that under them any inventions which are made by the employee belong in toto to the employer. For instance, where one employs another to make a device, pointing out the distinct and dominating feature of his improvement, although he does not make anything resembling a perfect drawing for the guidance of the other, or describe the proposed construction in detail, the maker of the device is not entitled to claim the invention, although by reason of his mechanical skill, he may have made a neater and more perfect device than was in the mind of his employer. A member of a firm which was engaged in the jobbing sale of various novelties wishing to get out an improvement upon a device which his firm handled, employed a person engaged in the manufacture of electrical and brass goods to prepare a model for him. The novelty consisted of an arrangement intended to be fastened to bath tubs, there to perform the functions of a soap holder. The employer was something of a mechanic, having spent the years of his youth as apprentice and journeyman in the shops of manufacturing jewelers. He claimed that the improvement was suggested to him by objections raised to a soap holder which was on sale by his firm. In giving directions for the making of the novelty, the employer did not make anything resembling a drawing for the guidance of the party who was to do the work, nor did he describe the improvement in detail. But he pointed out the distinctive and dominating feature of his improvement, and he reasonably accounted for the lack of particularity of detail by saying that he was talking to a mechanic familiar with similar devices then in use and one who had been employed in their manufacture. When the device was finished each party filed an application for a patent, but the employee got his application in four days ahead of his employer. In an appeal from the decision of the Commissioner of Patents it was held that the employer was nevertheless entitled to the patent. It was undoubtedly true that the employee, by means of his mechanical skill and knowledge of the art, had made a neater and more perfect device than had been in the mind of the person by whom he was employed, but he was not entitled to claim the invention on that ground alone. An inventor, who employs a mechanic to embody his conception in practical form retains his exclusive right to the perfected improvement notwithstanding the perfection is partly due to the exercise of the mechanical skill of the employee. In order to be entitled to anything in the premises the latter must "invent" something, not merely improve, by the exercise of his mechanical skill, upon the conception which he has been employed to work out. Huebel vs. Bernard, 15 App. Cas. (D. C.) 510.

In Annin vs. Wren, 44 Hun. 253, the plaintiff was engaged in the manufacture of iron trucks and wheelbarrows of sheet iron. In February, 1883, he employed the defendant, George Wren, at a weekly salary of $18, to apply himself personally to the development of the business and to develop the truck and wheelbarrow made by the plaintiff. Wren, being a skilful draughtsman, made detailed drawings of the proposed improvements and patterns were made in accordance with the drawings. The design was to get patents for the improvements and engage outside capital in the enterprise, and the patents were expressly to be in the name of the plaintiff. In 1884, the employee made application for a patent for truck improvements and assigned the same to the defendant, William Wren, who obtained a patent therefor in his own name. This action was brought to compel William Wren to assign the letters patent, which had been issued to him, to the plaintiff, and it was held the patent equitably belonged to the plaintiff. The special service of inventing was the entire scope of the employment. There was no room left within the employment for inventing by the employee on his own hook. The employee had no right to think or invent for himself on the particular subject matter in hand. He could not carry off both his salary and the only valuable product of his work under such employment, leaving his master with his useless models, the result of his uselessly spent money on tools, machinery, time, labor of self and employees, with only a license or shop right which is not assignable or useful in any way save to himself. Such a result would necessarily have defeated the whole purpose of the contract and the contracting parties.

In Sparkman vs. Higgins, 1 Blatch. 205, the plaintiffs brought a bill to enjoin the making of oilcloths of a certain patented

pattern and the defendants set up in defense that the plaintiffs were not the original inventors, but that one in their employ actually made the invention. This, if true, would be a sufficient ground upon which to deny the plaintiff any rights in the matter. In regard to the making of the invention, it appeared that the plaintiffs would inform the employee in question that they wished him to get up a pattern and would instruct as to what they wanted in a general way. If the pattern, when finished, did not meet their approval, they would criticize and suggest and perhaps alter and improve upon it. It was held that the plaintiffs and not their employee were the inventors. To constitute an inventor it is not necessary that he should have the manual skill and dexterity to make the patterns. If the ideas are furnished by him, for producing the result aimed at, he is entitled to avail himself of the manual skill of others to carry out practically his contrivance.

Where an employer conceives the result embraced in the invention, or the general idea of a machine upon the particular principle, and, in order to carry his conception into effect, it is necessary to employ manual dexterity, or even inventive skill in the mechanical details and arrangements requisite for carrying out the conception, the employer is, nevertheless, the inventor and the employee the mere instrument through which he realizes his idea. If any of the essential parts and principles of the machine are invented by the employee and introduced into the machine on his suggestion, a patent taken out by the employer is void. But if it appears that the employee merely suggests alterations in the form or proportions of the machine, then the employer is entitled to the patent. If a contrary doctrine were to be maintained, very few patents could be upheld. Except in those cases where the inventor is also the mechanic who constructs the machine, patents would, in general, be necessarily held invalid. One's genius may be equal to the task of conceiving all the principles as well as the general structure and form of a machine. But he may be unacquainted with the use of tools, and be quite unable to anticipate in what manner the contemplated form of any particular part of the machine may affect its operation until the work is in progress and the materiality of form can then be readily discerned. That some alterations of the contemplated form or proportions should be found necessary would be, in most instances, to be expected. And who is more likely to perceive the necessity of it, and to suggest it, than the workman who is engaged in constructing the machine? If such suggestions were sufficient to invalidate the patent, few patents would be found equal to the test. Wellman vs. Blood, 29 Fed. Cas. 17,385.

An employee, performing work assigned to him, may exercise his inventive faculties in any direction he chooses, with the assurance that whatever invention he may thus conceive and perfect is his individual property. But this general rule is subject to certain limitations. If one is employed to devise or perfect an instrument, or a means for accomplishing a prescribed result, he cannot, after successfully accomplishing the work for which he was employed, plead title thereto as against his employer. Whatever rights as an individual he may have had in and to his inventive powers, and that which they are able to accomplish, he has sold in advance to his employer. One Clark, employed by the United States government as chief of the Bureau of Printing and Engraving, was assigned the duty, by the Committee on Ways and Means, of getting up the best self-cancelling revenue stamp which he could devise. Clark made use of the machinery and other property of the government and perfected a stamp which was accepted by the committee and the commissioner of internal revenue. No agreement was entered into between the government and Clark concerning the right of the former to use the stamp or the remuneration, if any, which should be paid for it. But it was understood that Clark was to make no charge to the government on account of the invention, as he was employed for the purpose of devising it. However, Clark assigned all his rights in the matter to a man named Solomons, in payment of a long-standing obligation, and the latter secured a patent and notified the government that he would like to arrange for a proper compensation to be paid him for allowing the government to use the patented stamp upon whiskey barrels. No attention being paid to his communication, he brought suit in the Court of Claims. It was held that Solomons' patent was invalid for the reason that Clark had never secured the right to a patent. Solomons vs. United States, 137 U. S. 342.

To sum up, the employer is the inventor and entitled to the patent where he conceives the idea of the invention, and employs others to carry out the conception, even though the latter use inventive skill in the details. But the mere fact that the actual inventor is at the time in the employ of another does not entitle the latter to a patent for an invention made by his employee. Inventions made and introduced without the employer's knowledge cannot be appropriated and patented by the employer. Even in cases where the inventor was expressly employed to exercise his inventive skill, the employer is not entitled to the patent unless there is an express or an implied agreement for an assignment, but the right to the patent belongs to the actual inventor. The employer, however, in such a case has an implied license to use the invention thus made at his expense. American and English Encyc. of Law, vol. 22, p. 349.

Boiler Blow-Off Connections.

By R. T. Strohm.

The various impurities that are carried into the steam boiler in the feed-water and that are left there by the subsequent evaporation of the water give rise to the necessity of periodical cleaning. But, thorough cleaning of all the interior surfaces and water passages involves the shutting down of the boiler and the cooling of its setting, a matter which is of no small importance in a plant where cutting out a boiler is followed by a decrease in output and a pecuniary loss.

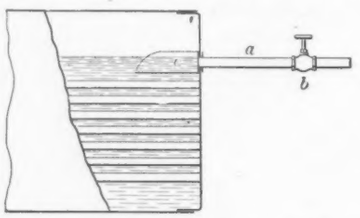


FIG. 1.—SIMPLE FORM OF SURFACE BLOW-OFF.

To obviate the necessity of opening up the boiler so frequently and thus wasting valuable time, methods have been devised whereby foreign matter may be drawn off from time to time without interfering with the regularity of working of the plant.

The impurities in feed-water, having once entered the boiler, will manifest themselves in one or both of two ways. Those that are light and flocculent will float on the upper surface of the water, and the heavier ones will sink to the bottom. As a consequence, it will be found that there are two distinct systems by which such impurities may be removed. One of these is the surface blow-off, and the other the bottom blow-off. Each consists of piping so arranged that at any desired

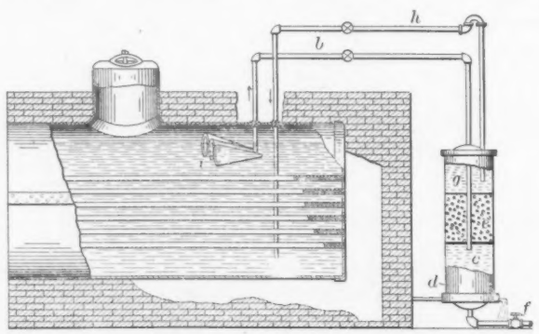


FIG. 2.—AUTOMATIC SURFACE BLOW-OFF.

moment the accumulated foreign matter may be blown out by the pressure in the boiler.

The simplest form of surface blow-off would consist of some such arrangement as that shown in Fig. 1, in which a small pipe, *a*, fitted with a valve, *b*, is screwed into the rear head of the boiler at the water level, a pan, *c*, being fixed inside to collect as much of the floating matter as possible and hold it near the outlet. By opening the valve *b* at intervals and for short periods, the impurities could be easily discharged. Such an arrangement is objectionable, however, in several respects. The pipe *a* is not a large one, and if the water level falls to any great extent, the outlet will be wholly uncovered, so that upon opening the valve, *b*, only steam would escape. Again, this device would be intermittent in its action, depending upon the care or thoughtfulness of the attendant.

As an improvement on such a crude system, the continuous automatic surface blow-off or skimmer was devised. Fig. 2 shows an apparatus of this kind. It consists of three skimming funnels, *a*, that open, at their small ends, into the discharge pipe, *b*, leading into the lower chamber, *c*, of the blow-off tank, *d*. The foreign matter is caught at the surface of the water in the boiler by the funnels and is carried to the chamber, *c*. From this point the water rises through the filtering material, *e*, leaving the sludge behind in the bottom of the tank, *d*, from which it may be blown by opening the valve *f*. The filtered water passes upward into the chamber, *g*, and thence to the boiler through the pipe *h*. A continuous circulation takes place

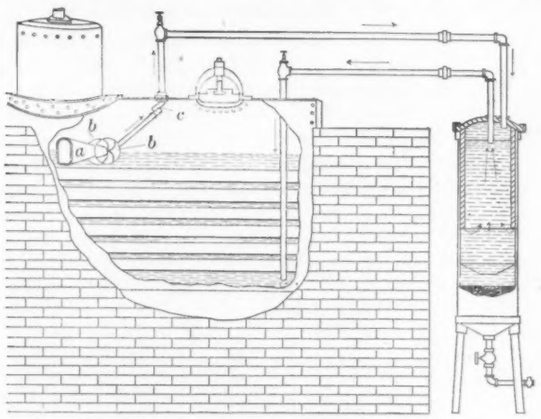


FIG. 3.—FLOATING SKIMMER FOR SURFACE BLOW-OFF.

throughout this system when the boiler is in service, and hence the skimming action is uninterrupted and independent of outside attention. Moreover, the hot water carrying the sludge to the settling tank is returned to the boiler, purified, and there is no heat loss beyond that due to radiation.

The device in Fig. 2 would become inoperative if the water level should rise above or fall below the mouths of the funnels, and they are made wide to allow of some fluctuation. The arrangement in Fig. 3, however, provides for any change of height of the water level, since the single funnel, *a*, is fitted with a pair of floats, *b*, *b*. The discharge pipe has a swinging joint at *c*, by virtue of which the floats are enabled to keep the funnel always at the level of the water. The remainder of the system differs only in details from the one already described and the principle of action is the same.

The method of arranging the bottom blow-off will depend on the type of boiler. Obviously, the blow-off pipe must be connected at a point where the scale and sludge would naturally collect, which would be at the lowest point of the water space. Another reason for locating it at the lowest point is that the blow-off must serve as a means of draining the boiler completely when it is desired to inspect it internally.

The ordinary return-tubular boiler gives greater difficulty in the location and protection of the blow-off pipe than any other type of boiler. As ordinarily set, the rear end of the boiler is an inch or so lower than the front end, and the blow-off pipe is screwed into the under side of the shell plate at the rear, as at *a* in Fig. 4. The circulation in the return-tubular boiler is such as to cause much of the scale to settle near the blow-off pipe, from where it may be blown out by opening the cock *b*.

However, it must be remembered that, with the blow-off pipe connected at *a*, it is directly in the path of the hot gases as they pass from the furnace to the tubes. Further than this, the blow-off is used intermittently and there is no circulation of

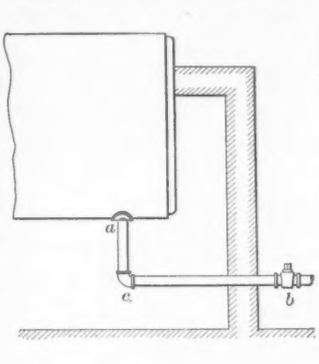


FIG. 4.—BLOW-OFF CONNECTION ON RETURN TUBULAR BOILER.

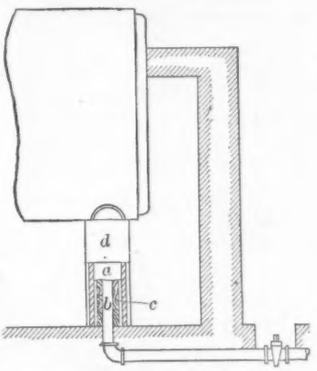


FIG. 5.—PROTECTED BLOW-OFF FOR RETURN TUBULAR BOILER.

water in the pipe. As a consequence, trouble is certain to arise unless reasonable precautions are taken to prevent it. With the arrangement shown in Fig. 4 it would be only a matter of time before sediment would collect in the elbow, *c*, where it would be baked hard by the intense heat and lack of circulation. The elbow and the vertical pipe would then rapidly clog with scale, and this scale would further prevent the heat from being transmitted to the water in the pipe. As a result, the pipe would be burned out, and would have to be replaced. That such trouble as this is very real and not uncommon may be inferred from the fact that some engineers have had to renew the bottom blow-off pipe as frequently as once in six weeks. Hence the need of proper protection of this important fitting.

First of all, the elbow should not be in the path of the hot gases. The arrangement shown in Fig. 5 will accomplish this, since the bend is beneath the floor of the setting, where it is protected by the brick and soot covering it. The blow-off pipe, *b*, is enclosed in a larger pipe, *a*, the space, *c*, between them being filled with mineral wool or asbestos. Outside of all, a third pipe, *d*, is placed, reaching from the shell to the floor beneath. Thus the vertical pipe, *b*, is completely protected from the action of the flames and hot gases.

Another method of protecting this pipe is shown in Fig. 6. Here a brick pier is built up around the pipe, extending from the boiler to the floor. The bricks are laid carefully in a mortar of fireclay and the whole is covered with a layer of fire-

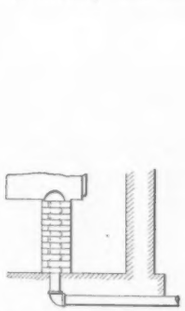


FIG. 6.—PROTECTED BLOW-OFF.

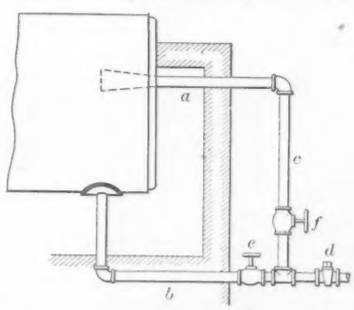


FIG. 7.—SURFACE AND BOTTOM BLOW-OFF CONNECTION.

clay after being built. This is a simple and effective way and is much used. Sometimes, instead of a rectangular pier surrounding the pipe, a V-shaped guard is built, with the point toward the front of the boiler. This is open at the rear, however, and is not so good as the enclosing brickwork. Still another way of preventing the pipe from burning out is to wrap it tightly and thickly with asbestos rope.

The manner of connecting the vertical pipe to the boiler should be carefully observed. It is not satisfactory to screw the pipe directly into the plate, for the plate may be too thin to enable a good connection to be made. Instead, a steel flange should be riveted to the boiler, and the blow-off pipe attached to this. Also, the pipe should be free to have a reasonable amount of expansion, which demands that it shall not be fixed too tightly in the rear wall or in the floor of the setting.

An additional means of prolonging the life of the blow-off pipe is to maintain a circulation through the pipe, as, for example, by the arrangement shown in Fig. 7. This shows a combination of surface and bottom blow-off, the discharge pipes, *a* and *b*, being connected by the riser, *c*. When the boiler is in

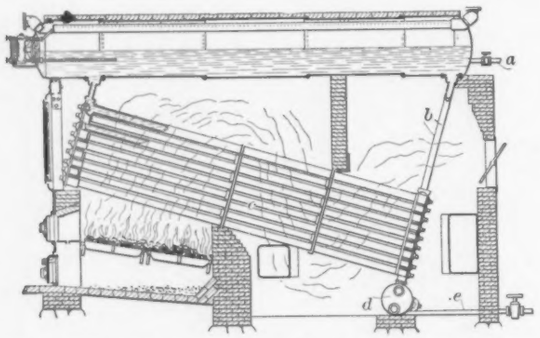


FIG. 8.—BLOW-OFF CONNECTION OF BABCOCK & WILCOX BOILER.

operation, the blow-off cock, *d*, is closed and the valves, *e* and *f*, are open, and there is a continuous circulation through the pipes, *a*, *b* and *c*, that prevents the collection of sediment in, and overheating of, the bottom blow-off pipe. When it is desired to use the surface blow-off, the valve *e* is closed and the cock *d* is opened. When the bottom blow-off is to be used, the valve *f* is closed and the cock *d* opened.

In all cases where the blow-off pipe is exposed to the hot gases it should be made of extra-heavy pipe in order to reduce the chances of failure. In fact, many specifications name extra-heavy pipe whether there is any protecting device to be used or not.

Where there are several boilers in service, it is not unusual to find them connected to a common blow-off main leading to the sewer. This is a questionable practice, inasmuch as it may become dangerous. Suppose that, while one boiler of the battery is open for inspection, the blow-off cock on one of the others should be opened. The consequences to an inspector inside the idle boiler would be terrible. This is no hypothetical case. Accidents of precisely this character are on record. Evi-

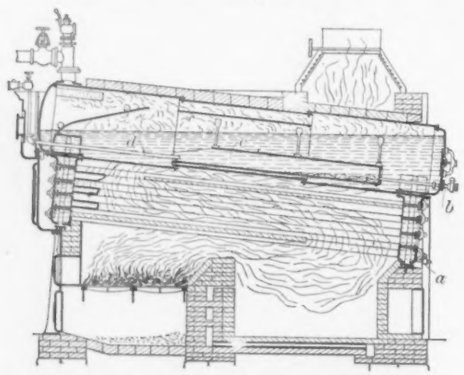


FIG. 9.—BLOW-OFF CONNECTION OF HEINE BOILER.

dently the safe plan is to have each boiler discharge through its own pipe.

In the Babcock & Wilcox water-tube boiler as illustrated in Fig. 8, the water is forced into the upper drum through the feed-pipe, *a*. The circulation then is downward through the risers, *b*, upward toward the front header through the tubes, *c*, and thence back to the rear in the drum above. The rear header is connected to a mud drum, *d*, that forms the lowest part of the water space. To this drum the blow-off pipe, *e*, is attached.

The Heine boiler, also of the water-tube type, has a double blow-off system. The usual bottom blow-off is provided at *a*, the lowest part of the rear water leg. An auxiliary blow-off, however, is installed at *b*. Suspended inside the steam drum, beneath the water, is a long drum, *c*, closed at the rear end but

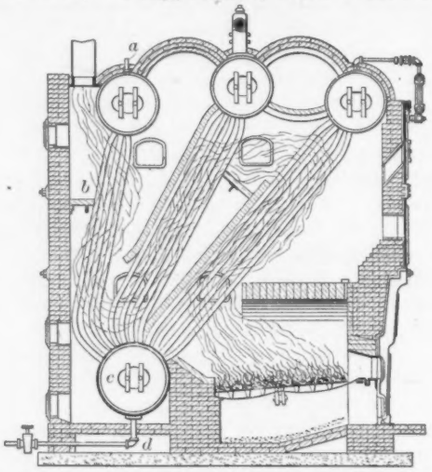


FIG. 10.—BLOW-OFF CONNECTION OF STIRLING BOILER.

open at the front. Into this drum the feed-pipe, *d*, discharges, and thus the incoming feed-water is heated to nearly the temperature of the surrounding water before it begins to circulate through the tubes. The result is that a large part of the soluble impurities are precipitated in the drum *c*, from which they are removed at intervals by the opening of the valve at *b*.

The Stirling water-tube boiler, differing in design from either of the foregoing, is shown in Fig. 10. The feed-water enters the rear upper drum at *a*, passes downward through the tubes

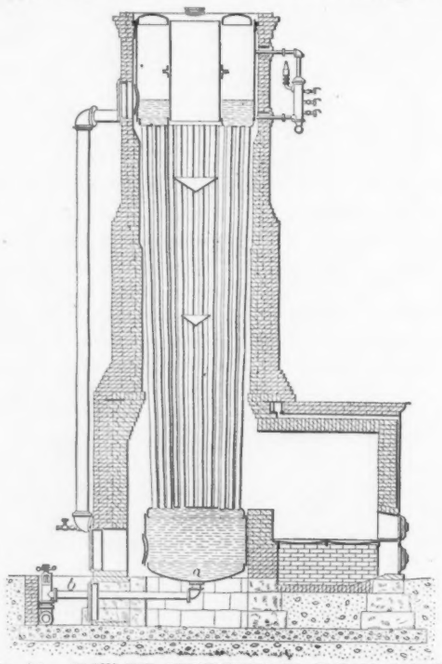


FIG. 11.—BLOW-OFF CONNECTION OF CAHALL BOILER.

b into the mud drum, *c*, and thence upward through the other tubes. At the bottom of the drum the blow-off pipe, *d*, is attached.

In the case of the Cahall vertical boiler, consisting of upper and lower drums connected by tubes almost vertical, as in Fig. 11, the lowest part of the water space is at the bottom of the drum, *a*, and this is the logical point of attachment of the blow-off pipe, *b*. Had the boiler been a fire-tube instead of a water-tube, the blow-off pipe would have been connected to the water leg at its lowest point.

LETTERS ON PRACTICAL SUBJECTS.

THE CARE OF ELECTRIC DRILLS.

Few pieces of electrical apparatus receive harder usage than motor-driven drills, and in many cases lack of proper care, coupled with severe service, have given rise to the impression that electric drills are not reliable tools. The proper maintenance of an electric drill is not a serious difficulty. Operation with reasonable care contributes its part to the reliable service which may be expected of a good drill, and a little intelligence exercised in the field will save many an interruption. The practice of using the wrong size of fuses in drill sockets opens the door to trouble, as does the habit often seen of dragging the drill around by its cable. When a drill refuses to start, ignorant operators will sometimes take it to pieces before finding whether the fuse is blown, or whether current is on the line.

In some styles of drills the use of oil on the armature bearings leads to insulation troubles. Even on spindle bearings, oil should be used sparingly. Small, rather than large quantities of grease in the gear boxes are desirable, and in most cases an application once a week or two, depending on the service, should be sufficient. Attempting to drill with dull drills, using larger drills than the outfit is rated for, and feeding too fast when the point of the drill is breaking through the stock, often lead to damage in the motor windings.

In case a drill refuses to operate, the first course should be to look at the commutator and brushes, throwing the drill switch several times. If no spark can be seen at the brushes when the switch is thrown in, the drill should be disconnected from the line, and a test made by lamp or otherwise, to find out if the power is on. If the fuse is intact and the commutator all right, a careful inspection of the commutator and brushes should be made to see whether one of the brushes is not being held off the commutator by dirt or grease. The remedy here is, of course, to wipe off both commutator and brushes, turning the armature completely over in so doing. If the trouble is not here, it may be in the switch. This applies to a search for an open circuit or a condition in which the drill does not get current.

If an electric drill refuses to work properly or overheats with an excessive spark visible at the brushes, the commutator should be examined for burning in any particular spot. If it is not burned, but simply dirty, a few drops of kerosene applied to it on a cloth will be sufficient to stop sparking. The brushes should bear on the commutator with a moderate pressure.

It occasionally happens that a field wire is broken, which causes excessive sparking and may cause the drill to run at far above normal speed. This can be found by removing the armature, then switching on the current, and trying the pole pieces for magnetism with a piece of iron or steel. If no magnetism is present, the field circuit is open, and an examination must be made to determine the exact point. Unless a break can be very easily repaired, it is better to send it back to the makers. If the commutator shows a decided burn between any two bars, or the armature coils are burned, as indicated by the insulation being scorched, the armature should be returned to the factory where it was made for repairs, or a new armature substituted. It is generally inadvisable to have local electricians mend such armatures. The only electrical trouble likely to occur is a ground, causing the workman to receive a shock when handling the drill. This can be located by testing the armature, fields and switch separately, using a test lamp and trying the circuit between the winding and the armature shaft or the housing of the drill. In cases where drills are operated from trolley circuits with a pole for the connection staff, a fuse block should be placed near the top of the pole so as to make it necessary for the operator to remove the pole from the line in order to replace the fuse.

BOSTON, MASS. K. S. HOWARD.

TINNING BLOCK FOR ELECTRIC SOLDERING TOOL.

During several years' use of the electric soldering tool, the writer has tried many ways of keeping the tool coated with solder, or "tinned," but thus far, a substitute for the homely but efficient "tinning brick" has not been found. Some sort of support must be used for the electric tool when it is being heated, and when not in actual use. All kinds of stands have been tried for this purpose, but a common clay brick answers just as well.

Fig. 1 shows the method used by the writer, in which two "soft" bricks comprise the entire outfit needed for supporting and for tinning the tool. As shown, one brick is used merely

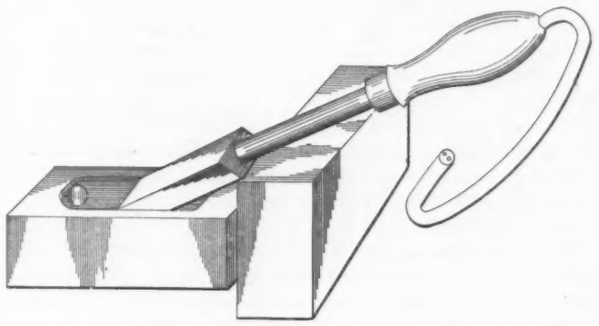


FIG. 1.—ELECTRIC SOLDERING TOOL.

as a support for the soldering tool, while the other brick is used to contain the tinning material and to furnish a material which will keep the copper bit bright enough to receive its coating of "tin."

Fig. 2 represents a section of the tinning brick, which is scooped out on top as shown by the lower line. The brick need not be hollowed out as much as shown. If a hollow place ½ in. deep is dug in the middle of the brick with a cold chisel, it will be enough to start with, and subsequent use of the tool in the act of tinning, will hollow out the brick as shown. In time, of course, it will dig a hole through the bottom of the brick, when a new brick will be necessary.

Into one end of the hollow in the brick, some sal-ammoniac is placed to help tin the copper bit. Sal-ammoniac is a natural flux for copper and aids greatly in keeping the tool well tinned. Next, as shown by Fig. 2, some melted solder is run into the hollow in the brick, and lastly enough resin to fill the cavity nearly to the top.

When the tool is not in use, the electricity is switched off and the tool permitted to lie in the resin. If it is desired to repair the tin coating a little when the tool is in use, the latter is rubbed on the brick below the layer of solder and the layer of resin. If the tool is in very bad condition, it may be pushed

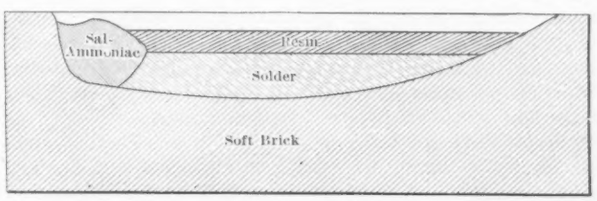


FIG. 2.—CROSS SECTION OF TINNING BLOCK.

into the sal-ammoniac once or twice and then rubbed in the solder again. It requires but little heat to keep the brick and its contents ready for instant use. In fact, the brick is a fair non-conductor of heat and prevents the escape of heat from one side of the tool.

When momentarily not in use, the tool remains in the solder which becomes melted underneath the layer of resin. When the copper bit becomes too hot, it will begin to volatilize the resin, thus calling the attention of the workman to this fact, whereupon, the electricity will be turned off from the tool, or

the amount reduced by means of a suitable resistance. Thus the apparatus is not only a stand for the tool, a continuous tinning arrangement, but it is an alarm as well, giving a smoke notice whenever the tool is getting hot enough to burn the tinning off of the copper.

Only a very soft brick should be used for this purpose. A vitrified paving brick is of no use. A soft yellow brick is preferable, although a fire brick can be made to answer fairly well. A sandlime brick does not work very well. It seems to "kill" the solder as well as the resin and the sal-ammoniac.

Detroit, Mich. John Jackson.

SOME BOILER AND PUMP TROUBLES.

A recent boiler and pump experience may be of interest to readers. When the boiler in question was opened and nearly three-sixteenths inch of very hard scale was found coated fast to the inside of the water tubes, it was high time that something was done to lessen the coal bills. The scale was so hard, and adhered so firmly to the inner sides of the tubes, that it seemed almost impossible to start the scale without destroying the tubes. For two days all the men that could get at the tubes, hammered away with cold chisels without seeming to make an impression upon the scale.

Next, a turbine scale remover was tried with 60 lbs. pressure in the water mains, and that tube cleaner made about as much impression upon the scale as a cheese bullet would upon a war ship. Next, a 6 in. x 4 in. x 6 in. duplex Worthington pump was placed convenient to the front of the boiler and connected direct to the turbine by means of very strong wire-wound rubber hose. The suction of the pump was connected direct to the water main and its 60 lbs. pressure, which forced a considerable stream of water through the pump when air was cut off from that appliance.

Compressed air was used in the business which operated the power plant and air at 90 lbs. pressure was turned into the steam end of that duplex pump. It can be easily understood that the pressure in the air chamber of that pump was something worth having. A pressure gauge applied to the water vent of the pump showed a fluctuating pressure between 180 and 240 lbs. to the square inch, and the manner in which the hose which was attached to the turbine cut up around the front end of the boiler was lively, to say the least, and it required the united efforts of two men to keep the turbine to its work and to control the very lively hose connection.

But, alas, though the turbine ran mightily, and tons of city water was wasted through the pump and the tube cleaner, the scale seemed to have decidedly the best of it, and two days' work only saw 15 tubes cleaned—and of those 15, out of 70, how many of them would be tight after the scaling operation is complete? That is a mighty question, and it is pretty safe to say that many, if not all of those tubes will leak so badly that it will be impossible to run the boiler without further repairs. Once a water tube is so badly coated with scale on the inside, that so heavy a pressure is necessary to remove the scale, it is almost a foregone conclusion that the tubes will be so nearly destroyed in forcibly removing the scale, that they will prove worthless and must be replaced before the boiler can be operated to advantage after the cleaning.

Instead of letting a boiler go until such a heavy scale formation results in enormously increasing the coal consumption, how much better it is to use continuously the necessary amount of the proper solvent, that the scale may be chemically removed from the tubes. Then, use the necessary chemical in the feed water to prevent the formation of scale, or use such purifiers as may be found necessary. But, the question is asked: "How is all this to be determined—the 'proper solvent' and the 'necessary chemical'?" Well, that is easy. Just send a sample of the water to a reputable chemist and have the liquid examined for substances detrimental to steam boilers.

The chemist will very soon tell just what salts are contained in the water, and he will also tell what chemicals should be used be used to prevent scale formation. If the impurities held in solution in the water are of such nature that they may best be removed by means of a feed-water purifier, then the chemist will determine that fact also, and by following his advice, the steam boiler will never have its tubes knocked to pieces by 240 lbs. hydrostatic pressure in a turbine tube cleaner.

The detection of leakage in the water-end of a duplex pump was most graphically illustrated during the use of the steam pump as described above. It was thought that there was considerable leakage past one of the water pistons, and to determine which one, a pressure gauge reading up to 300 lbs. was attached to the pump by removing the pet-cock from the top of the water-end of the pump. The water-delivery pipe was throttled by means of a valve until the pump was working up to about 240 lbs. as indicated by the gauge. Of course, this pressure would not be maintained all the time, but would fluctuate during each stroke, but it was noted that the pressure was maintained very steadily while one of the water cylinders was working, and that the pressure fell off very fast while the other cylinder was at work.

This occurrence demonstrated that one of the cylinders leaked badly and it furthermore showed that there was more leakage at one end of the water cylinder than there was at the other end. By completely closing the valve in the discharge pipe, and then running the pump, the amount of leakage which existed was plainly shown. When it was demonstrated that this pump would make nine complete strokes a minute with the discharge valve tightly closed, then the owner commenced to figure what the existing leakage in the water cylinder was costing him for coal. This leakage is, of course, in addition to the leakage of steam which might be taking place past the steam piston. This leakage is easily detected by removing the exhaust pipe and running the pump very slowly with the exhaust passing freely from the pump into the room.

Sometimes it is found that steam literally blows right through the pump, and that the waste of coal from this cause alone, is something enormous. In more than one instance, steam enough thus leaks past the pistons to run another pump of the same size as the one under consideration. The steam leakage, added to the steam used by nine strokes a minute extra for water slippage, sent the steam consumption of this pump up to 325 lbs. of water to each horse-power-hour! Rather an expensive pump to operate? And this pump, with all its expense, can be found running in duplicate in many an engine room.

The two easily made tests above described should be frequently applied to every steam pump and the results, if carefully noted and acted upon, will save a considerable amount of coal to the engine owner.

Willoughby, Ohio. James F. Hobart.

A SHEET-IRON BELT.

When looking over a thirty-year-old book recently, I came across the following description of a sheet-iron belt, which may be of interest to your readers:

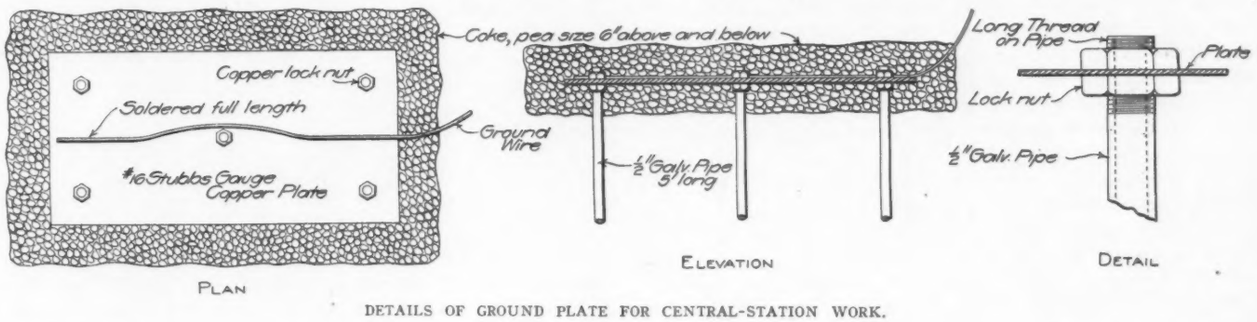
"Mr. John Spiers, of Worcester, Mass., gives us an account of a sheet-iron belt. A lathe used for turning rolling-mill rolls, compound geared, has a 48-in. pulley on it; this is driven by an 18-in. pulley on the countershaft which makes 120 r. p. m. and is 8 ft. from the 48-in. pulley measured from center to center. Both pulleys are of iron, smoothly turned on faces. A 7-in. double-leather belt was used on these pulleys, but would slip when the turning tool became dull. This belt was replaced by one made of Russia sheet iron, such as is used for stove pipes and parlor stoves, and was riveted together in the ordinary way; it was 7 ins. wide and 2 ins. longer than the leather belt. This extra length made up for the want of elasticity in the iron. During one year's steady run this iron belt could not be slipped, even when a heavy cut on a 25-in. roll was taken, which broke a 'Sanderson' steel tool having a section of 2 ins. x 2½ ins., a cutting surface of 2½ ins., a feed of ⅛ in. per revolution, and an overhang of 4 ins." This is certainly a novelty in belt drive and appeared to have worked very satisfactorily, although one would hardly have expected sheet iron to stand constant bending for such a length of time.

Buffalo, N. Y. George C. Pearce.

GROUND PLATES FOR CENTRAL STATION WORK.

I give herewith a method of making a ground which appeals to me as being very serviceable. The writer has been impressed of late with the vagueness of the data available with regard to the proper size and method of installing ground plates for central station work. The method of grounding described has been adopted in our new plant and, while original with us, may be of service to others who have similar work to do. We procured a plate of No. 16 gauge copper 3 ft. x 6 ft. as advised in the National Electric Code, and dug down until we struck earth which seemed to be permanently damp. The plate was pierced by five ¾-in. holes, spaced equally and laid in the bottom of the hole to be used as a template. Five lengths of ½-in. galvanized pipe were threaded about 1½ ins. at one end and shaped into a rough point on the other end. These pipes were driven into the earth by means of a driving cap, through the holes in the copper plate, care being taken not to injure the threads. About 6 ins. of the pipe were left projecting above the plate. The latter was then removed and powdered coke filled around the projecting pipe ends to a depth of about 6 ins. A copper lock-nut, made from a piece of bus-bar drilled and tapped, was screwed on the end of each pipe and the copper plate replaced. Another copper lock-nut was then screwed on each pipe, thus fastening the copper plate securely in position over the powdered coke. Powdered coke to a depth of 6 ins. was then spread over the copper plate and the hole filled with earth. The usual form of connection to the plate was varied a trifle to make it a little more secure. A No. 2 bare wire was doubled on itself and the loop soldered the length of the copper plate, giving two ends to which the lightning arresters and other apparatus were connected. The accompanying illustrations show very clearly the manner in which the ground connection was made. In addition to this plate, a wire was run from the arrester to the water piping of the building, thus making two separate grounds.

AMES, IOWA. FRANK K. SHUFF.



DETAILS OF GROUND PLATE FOR CENTRAL-STATION WORK.

BOILER BRIDGE-WALLS.

Why is it that so many people use inferior things when it costs no more—perhaps much less—to have the best? It surely is a sort of inherent depravity to which mankind is heir. The writer is thus moved to express himself after looking at a bad case of boiler setting which seems rather more a monument of stupidity than a creation of a supposedly competent engineer.

Fig. 1 illustrates a common-sense bridge wall, one made for the purpose of preventing the fuel from being pushed off the back end of the grate before the fuel is consumed. In the engraving, the wall is shown at *a* as having been built up about 10 ins. above the grate, and as shown at *b, b,* in the end elevation, the wall is straight from one side of the furnace to the other. Behind the bridge wall is a generous back-combustion chamber, the passage through which imparts a very slow velocity to the gases during the combustion period, giving time for combination of oxygen and carbon, and the full development of most of the heat possible.

Fig. 2 represents a very common form of bridge wall, and one which the writer never could find any excuse for. As shown by the illustration, the wall follows the curve of the boiler and is built from 10 to 15 ins. distant from it. The writer has seen some 72-in. boilers with less than 8 ins. between the curving bridge wall and the shell of the boiler. Why some people should imagine that more heat will be imparted to the boiler when the hot gases are all driven against the

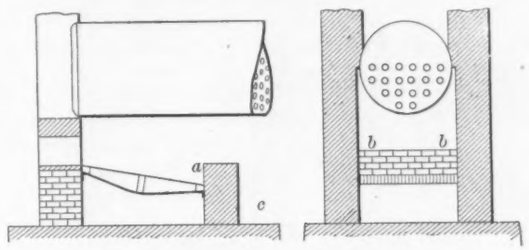


FIG. 1.—COMMON-SENSE BRIDGE WALL.

shell in one spot, is more than he can figure out. If this theory were true, it would be unnecessary to have any heating surface to the boiler except a small portion against which all the products could be driven, and as close to the grate as possible.

The men who set boilers in this way, or who design such settings, do not seem to consider that it requires a little time for heat to pass through any conducting material, be it boiler shell or water, and that when the velocity of the hot gases is made very high by passing all the products of combustion through a contracted area, the heat cannot have the time necessary to pass through the boiler shell; consequently, the gases pass into the chimney at a very high temperature and the best results are not obtained from the amount of fuel burned.

It is, therefore, necessary that the flame and smoke passages be so large that the products of combustion have plenty of time to give up their heat to the contents of the boiler and do not get a free ticket to the smoke-stack. In many instances, combustion does not begin to be completed by the time the gases get to the entrance to the tubes at the back end of the boiler. When this is the case, it will readily be seen that anything which hurries the gases through the passages under and inside the boiler, is a source of loss instead of gain. Hence the value of plenty of room under the boiler, and the injury done by contracting any of the passages with walls or other structural work, so as to increase the gas velocity at any point.

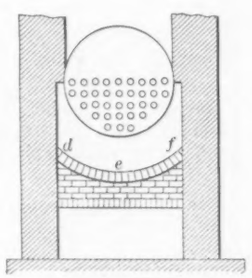


FIG. 2.—CIRCULAR BRIDGE WALL.

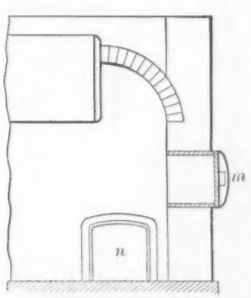


FIG. 3.—LOCATION OF CLEANING DOORS.

Another way in which the passages are cramped under the boiler, is shown by Fig. 4. In this case, the man who set the boiler evidently got it into his head that the flame should be kept as close to the boiler as possible, hence the trouble he went

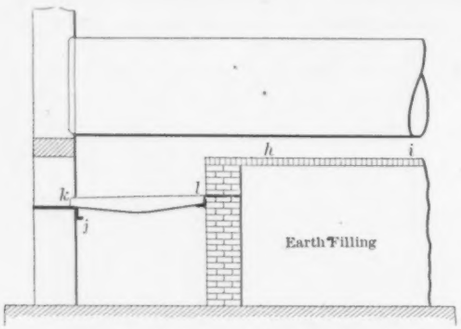


FIG. 4.—BACK COMBUSTION CHAMBER OMITTED.

to to put in a paved surface back of the bridge wall, and the keeping of the surface in question as high as possible, instead of allowing lots of room in back of the bridge wall for the completion of the combustion process.

Fig. 4 illustrates an example of this kind of boiler setting. A front was secured which had the fire doors too close to the boiler to begin with, and not even being satisfied with that, the boiler setter raised the grates from their bearing plate shown at *j*, and placed them on top of the dead plate, where they remained gloriously in the way, and in constant danger of falling off the back bearing plate into the ash pit. The manner of placing the grates is shown at *k*, and in addition to this, instead of the back end of the grate being lower so as to get the fuel in place with the least work possible, the grates were raised as shown at *l*, still further contracting the already too small combustion chamber above the grates.

To make bad matters worse, the bridge wall was carried up very high as shown at *h*, and the space back of the wall, which should have been a large combustion chamber, was filled full of earth and paved with bricks as shown at *h, i*. This answered so perfectly to cut down the combustion space, that it was impossible to burn any kind of fuel without causing smoke in abundance. The gases did not have time to burn, so quickly were they forced through the boiler by the most direct way possible.

Just one more "knock" against the manner in which some boilers are set, and the writer will stop off his "unconsumed gas." Fig. 3 shows the manner in which this abomination is sometimes placed. The only opening through which the combustion chamber may be reached for cleaning, is, as shown, very small, and the cast-iron frame is set nearly 3 ft. from the ground or floor line. The only way to get the dirt and fine ashes out of the combustion chamber is for a man to crawl through the small opening *m* (which is closed by means of a small loose door or cover) and shovel out the ashes with a small shovel which can work through the opening *m*. Whenever a door is placed in the back combustion chamber, let it be placed on the floor line as shown at *n*. Then the ashes can be easily shoveled out into a barrow, with some degree of comfort.

New York City. James Francis.

POSSIBLE SOURCES OF ECONOMY IN STATIONS.

There appear from time to time elaborate theoretical dissertations on possible sources of economy in steam plant operation, and while these are interesting in that they show in which direction to look for best results, they seldom are within the grasp of the ordinary operating engineer in many plants or in many cases to the owner, either. The latter is confronted with coal bills, engine bills, etc., to which no theory is attached, and which he is able to comprehend at a glance. Few firemen, I take it, ever concern themselves with the question of evaporation; notwithstanding that the rate at which water is evaporated is a factor in fuel economy, and that there is a most economical rate of combustion per square foot of grate surface for a certain make of boiler using a certain quality of fuel. Opinions differ as to what the best rate of steaming is, so that it would be best to determine this in each individual case. To ascertain positively the best rate of steaming for a given battery of boilers, a number of tests should be made at various rates of evaporation, and with the quality of coal that is ordinarily used. The fuel consumption per unit rate of evaporation should be compared in each case. Where it is possible to obtain more than one kind of fuel, a complete set of tests at different rates of steaming should be made with each kind of fuel and the results compared. Instances have been cited where it was found economical to increase the load on boilers already heavily overloaded by cutting out of a battery. Other boiler-room economies have been pointed out in this and other publications from time to time, so that it will not be necessary to touch on them here. One question, however, has not been given the attention it merits, and that is the question of superheated steam. Economy is the central idea involved in the use of superheated steam, and this gain arises through an improvement in the limiting conditions to engine economy. The condenser pressure furnishes the limit to the temperature of the exhaust, but by elevating the admission temperature economy is possible. Leakage is reduced in the engine cylinder also, as well as condensation in the steam-engine cylinder and steam pipes. The number of types of superheaters is large. Some are independent of the boiler; others are in the boilers themselves, but both can be installed without much disturbance to the existing plant. The use of superheated steam leads to the question of best engine installation. Can the combination of an efficient reciprocating engine and good condenser be bettered? Under ordinary working conditions a condensing engine represents a closed cycle, so that another cylinder may be added to get all the work possible out of the steam and still have all the advantage by condensing it. Lately instead of adding another cylinder, a steam turbine has been introduced between the engine and the condenser, and in this way, it is said, very great economies are obtained. So well has this proposition been received that there is now building a large steamship in which two sets of quadruple expansion reciprocating engines will be used in connection with a low-pressure turbine, each having its shaft and propeller. Low-pressure turbines are used in connection with reciprocating in Philadelphia, and also in Scranton, Pa. Reciprocating engines lend themselves admirably to the utilization of high-pressure steam; but not so to low-pressure steam. Any attempt to attain complete expansion would result in friction losses, exceeding large and cumbersome cylinders, etc. The turbine, on the contrary, is able to use steam at low pressure and to derive the benefit of the vacuum given by a condenser. It is for this reason that improved condenser efficiency has been given an impetus, since the reciprocating engine cannot make so advantageous a use of a high vacuum as the steam turbine. The facts regarding the Philadelphia and Scranton low-pressure turbins have already appeared in type, and it would be interesting if readers having definite information as to very low back pressures in reciprocating engines and also information as to their economy would send in the facts for publication. The use of low-pressure turbines does not seem to be increasing rapidly, so that possibly the marked economy claimed for them is not realized.

New York City. Charles J. Thomas.

NON-PATENTED ARTICLES.

In reading the article by Mr. J. E. Brady in the first issue of October, in which the use of the caveat in protecting inventions is described, a plan having an end quite different from that of a caveat was brought to mind, and which first occurred to me some years ago. This is an arrangement whereby an inventor may register his invention at the Patent Office as non-patentable, thus placing on file a record which in cases may prevent a patent being issued on the same idea to a later inventor, which patent might, through litigation, cause expense to

the prior inventor if he is manufacturing the article on which, for one reason or other, he did not care to take out a patent. Any expense to the Patent Office could be covered by a small fee.

PITTSBURG, PA. I. T. HEINZ.

CONSTRUCTION OF HIGH-TENSION CONDENSERS.

The best known form of condenser for high-tension work is the Leyden jar. In cases where a fairly large capacity is desired, this form of condenser becomes entirely inadequate, due to its bulky size, and provisions must be made for piling-up a

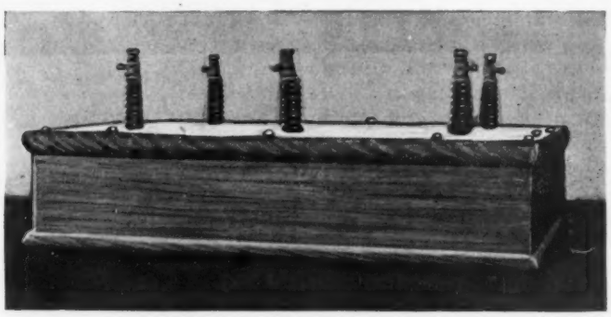


FIG. 1.—HIGH-TENSION CONDENSER.

large number of tinfoils and dielectrics into a smaller space than that occupied by the Leyden jars.

One of the best dielectrics for high-tension condensers is glass. All of the glass used must be of a nearly uniform thickness and free from blow-holes. Common window glass, if properly selected, answers the purpose admirably.

A good insulating material in which to dip the condenser plates consists of the following: Rosin, four parts; ozokenite, one part; vaseline, one part, by weight.

All of these materials must be pure and free from acids. The compound has the desirable property of adhering to the

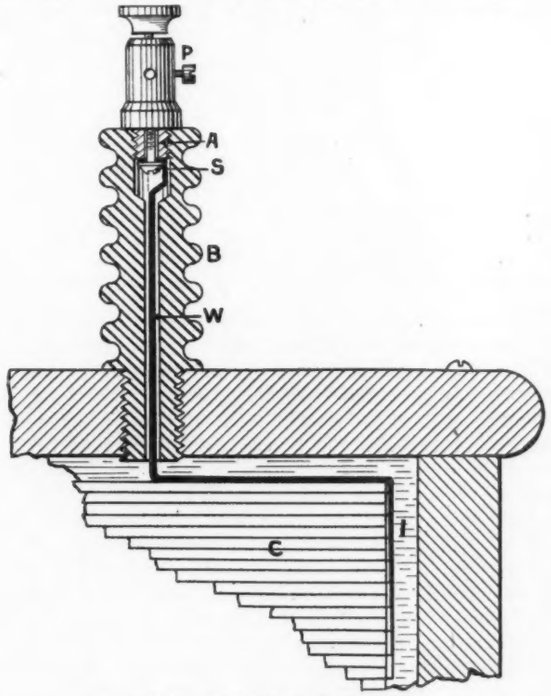


FIG. 2.—DETAILS OF CONDENSER.

glass at all temperatures. It is extremely flexible, and if the plates are properly dipped, it will possess a marked freedom from air-bubbles.

In Fig. 1 is shown one of eight condensers constructed with these materials by Mr. George M. Albrecht and the writer at the electric laboratory of the University of Minnesota. Four of these were arranged with five terminals leading to one, two, four and eight surfaces (total, 15), and the other four had 16 active surfaces of tinfoil each. Some of the principal details in their mechanical construction will be briefly given.

The tinfoils were cut 1 in. wider than necessary on one edge and an incision was made therein extending to within an inch of the edge of the foil. This construction provided a flap of tinfoil which by suitable folding was formed into an ear and used as a terminal for the foil.

The tinfoils were fastened to the glass with turpentine, all air-bubbles being removed from between the two surfaces by means of a roller. They were then heated for some time at a temperature of from 100 degrees C. to 115 degrees C. in order to dry the turpentine.

After this treatment the slates were dipped into a pan containing the aforementioned molten mixture, precautions being taken to have the bow of the glass all in the same direction.

After the mass had cooled it was removed from the pan, and the excess of insulating mixture was removed from the edges.

To form the connections with the binding posts the following scheme was used: A flexible wire was soldered to the ears of the foils, and led through the base of the binding posts. These binding posts were mounted upon a hard rubber base (*B*, Fig. 2), the surface being corrugated to prevent leakage.

The method of making connections is shown in Fig. 2, where *C* is the condenser, *W* the wire leading through the base *B*, which is attached by the screw *S* passing through the threaded brass plug *A* to the binding post *P*. The whole is then screwed into the base *B* and a suitable connection is thereby formed.

The condenser is then inverted and filled with the molten mixture, and the bottom of the box is screwed down.

The following data are from eight condensers having 124 active surfaces of 8.5 in. x 10.5 in. and glass plates 12 in. x 14 in., varying in thickness from .085 to .102 in.

Total capacity on instantaneous charge, .168 m. f.

Total capacity on slow charge, .215 m. f.

Thus the absorption was about 25 per cent.

These condensers safely withstood 20,000 volts alternating and they showed no tendency toward breaking down.

A test condenser made up of three plates of glass .075 in. thick and two sheets of foil dipped into the above mixture withstood 33,600 volts. It is noteworthy that when the condenser broke down the glass cracked near the corner of a foil; that is, where the charge was the most intense.

MINNEAPOLIS, MINN. E. L. WEBER.

WORTHLESS SPECIFICATIONS FOR ELECTRIC WORK.

Accompanying this is a copy of the complete specifications issued from the office of an architect and supposed to cover the wiring of a building. The copy is given verbatim. The architect states that the specification is intended to cover a "knob and tube" job. We have had hundreds of specimens in the past few years which were worthy of attention, but the present one we believe is the most interesting curiosity we have ever run across. Very likely it may be of some interest to your readers. Any man engaged in contracting business at least will appreciate the real humor of a specification of this kind.

ELECTRICAL WORK.

The contractor shall pay all charges for the inspection of the work, and upon its completion secure a satisfactory certificate of its acceptance, at his own expense, the very best service and secure likewise, at his own expense, for a period of two years, the efficiency of the system, and shall submit both to the architect.

SYSTEM.

The building shall be thoroughly equipped from the service of supply to each outlet with best insulated condition, put up in such manner as to provide continuous insulating channels for all wires, and the tubes to be so well connected as to exclude water and gas. All wiring shall be done in a thorough and workmanlike manner, and to be well insulated and wrapped at each and every joint. Place wires as shown on plans and leave enough wire so as to be able to connect with fixtures when necessary. The owners will provide all lights and the electrician set same in place. Place all necessary shut-offs and cut-offs on each fixture and place a switch at head of stairway to cut off hall lights on first floor. Also place a switch at bottom of stairway to shut off or turn off lights at head of stairway.

WILKES-BARRE, PA. G. E. SHEPHERD.

QUESTIONS AND ANSWERS.

How may a direct-current generator which has stood idle for a long time in an unused factory be dried out? B. W.

If the generator is a compound-wound machine, short circuit the armature through the series winding and increase the speed from rest until full-load current is obtained.

Where can copies of the results of the fuel tests at the Louisiana Purchase Exposition be obtained? We understand that these tests have been published. L. C. I. L. & W. Co.

The results of the tests were published by the U. S. Geological Survey in three volumes. For copies apply to the Department of Interior, Washington, D. C.

Kindly advise me what impurities to look for in storage-battery acid and how to test for them. J. H. O.

The ordinary commercial acid is liable to contain traces of metals and also traces of other acids. Other impurities present may be due to the use of ordinary water from the water mains rather than distilled water. Tests for these may be found in any book on analytical chemistry.

In a recent issue mention was made of a dynamo giving approximately a constant output with varying speeds. A machine of this character should be suitable for use with a wind mill, and as we have inquiries for such installations, we would be obliged for further information on this dynamo. L. H. & Co.

The machine referred to is known as the Rosenberg dynamo. This generator was described in the columns of the Electrical World and Engineer of July 15, 1905.

Will a Westinghouse synchroscope designed for 60 cycles operate satisfactorily on a 25-cycle circuit, or vice versa? If not, what changes are necessary? J. T. B.

If the synchroscope is designed for 60 cycles and it is desired to operate it on a 25-cycle circuit, the following changes will be necessary: The field coils should be connected in series instead of in parallel and the impedance coil should be readjusted for one ampere at 100 volts.

What is the resistance of a person's body from hand to hand and from hands to feet? How much current does it take to kill a person? Will two contacts on an arm or leg have as great an effect as when the current passes through the body? H. C. T.

The resistance of a person's body and the amount of electricity it takes to produce fatal results depend entirely upon the person. It is generally recognized that the most dangerous path through the body is from hand to hand across the region of the heart.

What is the function of the reactance coils used in conjunction with rotary converters? S. B. C.

Reactance coils are used in conjunction with rotaries for traction purposes to obtain the necessary compounding effect. These reactance coils would be replaced by induction regulators which enable the impressed e. m. f. on the rotary slip rings and consequently the direct-current voltage to be varied at will, if the rotaries were used for delivering direct current for lighting circuits.

How may the direction of rotation of a rotary converter be changed? E. L.

If the supply is two-phase, reverse the two leads of either one of the phases, and if the supply is three-phase, reverse any two leads. Should the machine refuse to maintain its voltage, it will be necessary to reverse the terminals of the field circuit so that the field current may be in a direction to assist the field magnetism.

I have several 5-hp armatures to rewind. These are of the four-pole type, four-path winding, with 44 slots and 44 coils in two parts. The coils are placed thus: The top half in slot one and the bottom half in slot ten, and are so arranged that the coils do not come in pairs; that is, the two coils that are together in the top of slot one are divided in the bottom of slots nine and ten. Will the armature work just as well if both coils are placed in the top of slot one and bottom of slot ten? If so, it would be more convenient to wind. C. H. H.

The armature will revolve at the same speed and give the same output if the coils are placed as suggested. The motor, however, would possess a greater tendency to spark with this arrangement, than with the old arrangement.

How can gas be excluded from conduit lines?

The best that can be done in conduit work is to minimize the entrance of gas into the conduit system. Paint the joining ends of the conduit with a hot compound of pitch tar, refined asphalt and wax tailings, and after saturating cheesecloth in the same compound apply the wrapping to the painted joint. A joint made in this manner is somewhat expensive, but the results obtained by this method appear to justfy its use. Burlap and liquid asphaltum is also used at the joints. After the application of the wrapping, the whole system should be enveloped in concrete.

Will a gasoline engine be serviceable for direct connection to a 75-kw direct-current dynamo, the output from which is used by incandescent lamp and elevator motors? H. R.

There is no reason why a gasoline engine cannot be used for this purpose. Some of the electric manufacturing companies are building at present portable gasoline engine and generator outfits with ratings as high as 25 kilowatts. We understand that the building of larger sizes is in contemplation. However, gasoline engines suitable for direct-connection to standard generators may be obtained. Any tendency to irregularity of speed may be overcome by equipping the engine shaft with a heavy flywheel.

There is a difference of opinion between the several state engineers as to the value of a steel and a wrought-iron boiler tube, and I am taking the liberty of asking for your opinion as to which is the better of the two? L. C. R.

For ordinary use there is little to choose between the lap-welded wrought-iron tube or the lap-welded steel tube, some conditions being favorable to the use of one and some conditions being favorable to the other. The insurance companies report that the tendency to pitting, other conditions being the same, is more prevalent in the steel tube than in the wrought-iron tube. The hot-finish steel tube is not as brittle as the cold-drawn steel tube and would appear to be the better of the two for boiler-tube purposes. There is a prevailing impression that the charcoal iron tube of 20 years ago was much better than the charcoal iron tube of to-day. The drawn steel tube is without doubt much better than the lap-welded steel or lap-welded charcoal iron tube and is now being used to a very great extent, especially in marine work. The U. S. Navy Department specifies the drawn steel tube exclusively.

What is a motor converter, and for what purpose is it used? O. B.

A motor converter is a modification of the ordinary induction motor-generator. It consists of a direct-current generator coupled to an induction motor, the two machines being electrically as well as mechanically interconnected. The high-tension current circulates in the stator windings of the induction motor without the intervention of a step-down transformer. Owing to the counter e. m. f. of the direct-current machine the synchronous speed of the rotor does not correspond to the speed of the revolving field of the induction motor, but it depends on the pole ratio of the machines. Assuming that the two machines have equal numbers of poles, the synchronous speed would correspond to half that of the revolving field. Currents are therefore generated in the rotor windings at one-half of the supply frequency and these currents pass into the direct-current armature by suitable cross-connections and are there commutated. Theoretically, in the case assumed, one-half of the power of the combination is transmitted through the shaft and the remaining portion through the electrical cross-connection. In the case of the rotary the direct-current machine acts as a generator; in the latter case the motor acts as a transformer and the direct-current machine as a generator. To a certain extent, therefore, the machine combines the advantages possessed by both a motor-generator and a rotary converter.

CENTRAL STATION SALE OF CURRENT.

Electric Power Business in New England.

The New England town as a field for new business differs somewhat from towns in other sections of the country. Each city or town has one or more large industries or a number of smaller ones, which furnish the greater proportion of the revenue earned by the citizens. Examples of such cities are Danbury, Conn., with its 40-odd hat factories, and Fall River, Mass., with its great cotton mills, each industry employing the greater part of the population of its respective city. With a population thus consisting so largely of mill or factory hands, the field for lighting is much narrower than that for motor applications.

The sale of electric energy to large mills in New England is, however, beset with difficulties, and especially so when water power has to be contended with. Throughout New England the numerous streams were quickly seized upon as a means to furnish power so that today almost every watercourse of any size has a dam across it wherever there is an available fall for the development of power. In some places, like Holyoke, Mass., on the Connecticut River, and Shelton and Derby, Conn., on the Housatonic River, large water powers have been developed by companies who sell the power at very moderate rates. Fortunately for the electrical companies there are two seasons of the year when water power is apt to prove inadequate; namely, during the winter, when the ice holds back the water, and in the summer when the river is low. Consequently other power sources have to be maintained for these emergencies, and the question of continuous operation resolves itself, on the one hand, into whether a manufacturer will pay a lighting company a high rate for energy to tide him over the period of insufficient water power or invest in a power plant, or, on the other hand, whether the electric company can and will furnish him energy all the year at a satisfactory rate to both parties. Naturally the importance of this class of business has incited effort on the part of central stations to secure it. When the same company controls or owns both gas and electric interests, which is the case in nearly every city, no attempt is made to introduce the gas engine as a source of power.

As an example of what has been done in the way of power business in New England, the case of the city of Fitchburg, Mass., will be taken. Mr. A. H. Kimball, the superintendent of the Fitchburg Gas & Electric Company, who has made a special study of power for the last 15 years, presents the Fitchburg situation as follows:

"Our business of supplying energy for motors began with the installation of a 15-hp, 500-volt direct-current motor in June, 1892, and from that time until July, 1903, the date of starting our present new three-phase station, the growth of this business was very slow. This was due to several causes. The business was new, and people were skeptical regarding our ability to give them good service. Rates were high and the electric motor was not the simple, reliable machine it is to-day. The modern methods of business getting of to-day were unknown and the principal argument we made to our prospective customer was that 'the electric motor was a good thing.' This also seemed to be the general opinion of the customer, too, but looking from the company's standpoint only. We had two actual cases where we could not give the energy away, and business in this department was slow. Gradually, however, matters began to improve, small customers were added here and there, and spoke well of electric motors to their neighbors, and by the spring of 1900 our connected load had increased to 110 horse-power in motors. In 1900 plans were started for an alternating system supplying lamps and motors from the same unit, but it was not until the beginning of 1902 that orders were given for apparatus and material that now comprise our new station, which we started July 1, 1903.

"At that time our motor load consisted of 234 horse-power in 500-volt direct-current motors. These we replaced as rapidly as possible by 550-volt, three-phase motors and started to acquire a larger motor load. It was at once apparent that to attract the attention of the manufacturers and business men to the advantages of electric motors, arguments regarding their economy, reliability, etc., must be backed by some actual facts and figures. The old argument that the electric motor was a good thing still held good, but the customer wanted to have the good things shown up in a detailed and comprehensive manner. In order to do this, I tabulated data, which are now made up every six months, ending January and July 1. Opposite the names of all our motor users are printed the horse-power the customer has installed, the kw-hours used for six months as shown by his watt-hour meter, the rate which he is paying per year per horse-power installed based on his six months' consumption, and the average horse-power used, which is based on a day of ten hours, or 1500 hours for the six months. From these figures can be obtained at once the amount the customer has paid for six months, and the ratio of the horse-power used to the horse-power installed. These figures have been of great assistance to us in obtaining new business, as we were able to demonstrate to a prospective customer that the electric motor is economical and efficient by showing him in detail the actual conditions as they exist in different classes of manufacturing in his own city.

"One of the first questions we ask a customer who is considering the installation of motors is the size of the motor he desires. He may say 5 horse-power, and follow this statement with the question, 'How much is 5 horse-power going to cost me?' According to our rates, a 5-hp motor on a meter basis running fully loaded ten hours a day would cost the customer $50 a month, which statement in 99 cases out of 100 would terminate our business transaction then and there. However, we find, for example, that this customer wishes a 5-hp motor for a wood yard for both sawing and splitting; we, therefore, turn at once to the same class of customers similarly equipped and find that Mr. Smith with a 5-hp motor has used 286 kw-hours in the last six months, and that the average horse-power use for that period was .254 horse-power. We also find another customer of the same class who has used 511 kw-hours at a cost for energy of $46.82, and with an average horse-power use of .445, while still another customer had used 602 kw-hours at a cost for energy of $52.78, or an average horse-power use of .535. These figures are at once conclusive and show our prospective customer that he can afford to use electric motors. These figures give an actual condition taken from a period of six months.

"This is simply one illustration of the method which we have used with very satisfactory results, and we find the figures not only valuable for business getting, but extremely interesting in showing the load conditions in different classes of business. It also gives an excellent opportunity for comparing the efficiencies of the electric drive in use by different customers, and I think an excellent example is to compare the results obtained by two firms in this city engaged in the same class of manufacturing, as follows:

"One has 30 horse-power in motors installed, consisting of one 15-hp, one 10-hp and one 5-hp motor, all belted to lines of shafting from which all machines are driven. For a period of six months, the average horse-power used by this customer was 11.23 The other customer has 25 horse-power installed, consisting of three 5-hp, three 2-hp, one 3-hp and one 1-hp motor. In this case no shafting whatever is used, each machine being driven directly by an individual motor with the switch within easy reach of the operator. The average horse-power used for the same period of six months in this case was only 3.22.

This shows to a marked degree the saving made by the elimination of friction and intelligent installation of motors, and should be very forcibly brought to the customer's attention when bidding for his business.

"It is seldom that a steam engine can be replaced by a single motor belted to the same driving shaft, and highly economical results obtained. We make a point in every new installation of 10 horse-power or over, and often in smaller installations, to test the total and individual loads of the motors, showing both friction and working loads. These tests are given to the customer with full details which show him the exact condition of his power plant, and it is then optional with him whether he shall make any changes to better this condition, which in many cases would warrant a considerable outlay and be the means of reducing his cost of energy.

"Over two years ago we were called upon to meet a demand for large power, something over 300 horse-power from one company manufacturing cotton goods. This power was divided between two mills, one 6000 ft. and the other 10,000 ft. from out station, and both adjacent to our main pole line. In order to obtain this business we realized that our rates must be reduced for quantity, and I prepared some careful estimates of the present and probable cost of production. Our minimum rate at that time was 2.7 cents per kw-hour for 5000 kw-hours and over. This rate was reduced by steps to 1.95 cents per kw-hour for 37,500 kw-hours and over, based on monthly readings; these terms were acceptable to the new company and a contract for three years was obtained. In September we were called upon to furnish energy to a third mill of this same company. In this mill the entire steam plant was shut down and 125 horse-power in motors installed. Since then, several other additions have been made in the three mills, and to-day the motor installation aggregates 715 horse-power. In order to obtain the addition of 125 horse-power mentioned, we made a further slight reduction in rates, bringing the minimum kw-hour rate down to 1.85 cents, or $40 a year per horse-power of 3000 hours, and obtained a new three years' contract on all three mills. A great deal of persistent and continuous work was required to obtain this business, but it was finally secured and is giving excellent service and satisfaction."

The Fitchburg Company has for distribution a handsomely printed and illustrated pamphlet of 36 pages entitled "Facts Regarding Electric Power Used in Fitchburg." The left-hand pages of the pamphlet contain illustrations of motors and their application to various classes of work. On the right-hand pages and opposite marginal classifications, such as "Operating Elevators," "Making Combs," are lists of the users in Fitchburg of electric energy for motors. The pamphlet is gotten up so attractively that it invites attention, and everyone contemplating the use of electric motors cannot avoid being impressed by the showing the pages make. The following list, compiled from the pamphlet, of the applications of electric motors in Fitchburg, indicates the effectiveness of Mr. Kimball's work:

Operating traveling cranes, operating trip hammer, operating lathes, operating ruling machine, making paper stoppers, making novelties; piano playing, medical apparatus, blowing forges, making ginghams, printing presses, operating dental engines, cancelling stamps, charging storage batteries, telephone ringing, sawing and splitting wood, operating blast furnace, ventilating, making candy, mixing dough, mixing clay, crushing stone, operating carbonator, operating portable drill, operating elevators, making ice cream, cleaning and grinding castings, grinding grain, grinding and roasting coffee, crushing coke, grinding meats, cutting leather, operating wood working machines, running circular saws, making combs, making curtains, blowing organs, washing bottles, making brooms, operating cash system, hoisting coil, making cotton yarn, compressing waste, horse clipping, saw manufacturing, running sewing machines, pumping, making shoes, operating machine shops, cream separator, buffing, polishing and grinding, linotype machines, massaging.

Mr. G. L. Sadler, manager and superintendent of the Nashua, N. H., Light, Heat & Power Company, speaking of the rapid growth of the power business and the methods he used in Nashua, said: "I believe that the business was there waiting for us, and after introducing the required generating capacity at our station, we started after this business. We knew every manufacturer and his needs in Nashua. We went from one to the other presenting arguments containing facts that were easily demonstrated or proved. I found that personal heart-to-heart talks, driving home conclusive facts, were of much greater value than advertising campaigns. A contract was obtained first here and there, business began to amount to something and to-day we are furnishing energy in amounts beyond our dreams of years ago. Our largest consumer is one of the largest glazed paper concerns in the world, to whom we furnish energy 24 hours a day, every day in the year. At present we operate only their finishing department, with an average consumption of 35,000 kw-hours per month, with such satisfactory results to them that we expect to furnish energy for the entire concern. Our business is still growing and is bound to grow for some time. We are making a thorough campaign on small motors, our energy man going through the territory like a fine comb."

The New Bedford Gas & Edison Light Company, operating in New Bedford, Mass., has just started a small-motor soliciting campaign. Mr. Charles R. Price, treasurer of the company, in speaking of the motor business said: "We have for a long time been aware of its value, of the many advantages it held over other power, and that if a satisfactory rate was offered we would have little difficulty in obtaining business. The effect of our power campaign thus far has justified our opinion. Our increase has been steady and we hope soon to have the small manufacturers of the city generally using our energy. Everything possible is done for the consumer in order to hold his business, and results have shown us that the helping-hand policy is an excellent one."

Colorado Discussion on the Sale of Energy for Motors, Signs and Heating Devices.

Mr. Charles Robbins, of the Westinghouse Electric & Manufacturing Company, presented a paper at the September convention of the Colorado Electric Light, Power & Railway Association, on "Central-Station Power Problems." The first part of his paper took up an analysis of the cost of supplying a load which is on only a few hours per day. He showed that the cost per kw-hour for purely peak load business is excessive. In order to sell energy more hours per day, he suggested that central stations divide the 24 hours of the day into three periods; one period including the evening peak lighting load, the second period including the day load up to the peak, and a third period including the balance of the day. They should then strive mainly to get business for the second and third periods. He stated that the daylight motor load should ordinarily be from 50 to 60 per cent of the peak load. Most of the effort should be devoted to increasing the load during the second and third periods. He suggested that separate solicitors should be assigned to the different periods. He also suggested that the solicitor looking after the peak load business should seek to sell light rather than kilowatt-hours, and should look after the securing of the best results with minimum demand by the customer by the exercise of good illuminating engineering. In this way the investment needed to serve the most unprofitable class of load would be kept down. All-day load and the load after the peak should be canvassed to the limit. This is the business upon which there is profit. The electric light company, like the merchant, sells some goods at little or no profit, but must make up this lack on the general run of the business.

In the discussion following this paper, Mr. Cowling, of Denver, said that the Denver company had a contract with the North Denver Water Company for pumping of water in which it was provided that pumps would be shut off between 7 and 9 p. m. in the winter. On account of this, a lower rate

was given. The company has two wells at the present time, but expects to put in 30. This is therefore an important prospect for load of the character classified under the second and third periods by Mr. Robbins.

Mr. C. K. Durbin, of Denver, said that among the central-station companies which he represented, he had in mind two contracts where the right was reserved of cutting off the service during the peak. President Tripp said that pumping for irrigation purposes was also non-peak load and should get a low rate.

Mr. Robbins showed how the central-station illuminating engineer could help the company by keeping down the investment necessary to serve the peak-load customer by skilfully planning the illumination so as to cause the least maximum demand. As an extreme case of this, he mentioned church lighting, where the revenue is very small and where a difference in planning the illumination may make considerable difference in the investment necessary to serve the church. He said that one station in eastern Pennsylvania is trying this policy.

Mr. C. N. Stannard, of Denver, asked for an enumeration of the different classes of business which Mr. Robbins would seek under his second and third classifications. Mr. Robbins replied that under the second class would come all kinds of day motor service. For load after the peak, or the third class, he suggested water pumping, operation of compressors and breweries.

Mr. J. C. Lawler, of the Colorado Springs Electric Company, inquired as to what success central-station companies were having in getting architects to consult with them on illuminating problems and on the wiring of buildings to include all modern electrical appliances.

Mr. C. N. Stannard, of Denver, said that his company found it was easy to interest architects in all progressive measures which would enable the architects to keep up to date. They have men detailed to call on the architects and make suggestions. In the case of new store buildings these men would ask for separate feeders to be provided for sign, show-window and display lighting, which would be taken on a flat rate. This field had been cultivated until now the architects will call up the company and ask for its man to give advice on various subjects. He believed this money well spent. It secures lighting and motor business that could not be obtained if provision were not made for it at the time the building was erected.

Mr. Robbins called attention to the extensive field for the operation of beer pumps by electric motors. This was the cheapest known method, and could be operated cheaper than a water motor or a pressure tank of carbon dioxide frequently used.

HEATING AND COOKING.

The question was then asked as to the extent to which electric heating appliances had been pushed in small towns. Mr. Stannard said that he recently talked with the engineer of a small central station, in the East, who said that enough irons had been placed on his company's circuits to make the Tuesday-morning peak load higher than the evening peak had been previously. Another question was asked as to the effect of electric heating and cooking appliances on the evening peak load. Mr. R. P. Bache, of Colorado Springs, thought it wrong to push electric cooking appliances for the reason that the load overlapped the peak. President Tripp also agreed in the main with Mr. Bache on account of the difficulty of competing with gas in cheapness, and because of the load overlapping the evening peak, but he admitted later in the discussion that in some towns where gas competition was not present it would be worth while, and that there might be a number of small appliances that could be profitably pushed.

Mr. J. F. Vail said that his company loaned out 1200 flat-irons to get them introduced. Many people preferred to own the iron, however, and they had been gradually changing over, so that now, at the end of two years, about 800 of these customers owned their irons, and only 400 were loaned. During the summer season he figures the increase in revenue from a customer due to the use of the iron at $1 per month per iron, or 70 cents average for the year around. His company now sells irons at cost and does not loan them. They are put out on two weeks' trial, under the supervision of a lady solicitor and demonstrator, who is given the services of a wagon to carry the irons. They had also done something with heating and cooking appliances. He personally has a coffee percolator, water boiler and other devices on the dining-room table, and practically gets breakfast on the table. These devices are not used for the evening meal, and therefore do not come on the evening peak. He believed there would be considerable profit for central-station companies in the future from this class of business. One of his customers was installing a modern electric kitchen for the consumption of which he would be allowed a rate of 3 cents per kw-hour. This would be the equivalent of gas at $1 per thousand. The regular lighting rates in Pueblo were 10 cents for the first two kw-hours per lamp connected per month, and 6 cents for energy consumed in excess of that. As heating devices were not counted as connected load, this practically gave the customer a 6-cent rate on small heating appliances and irons. He believed that small stations in Colorado where there was no gas competition and where coal was very high, could obtain considerable electric cooking load, and that for small appliances there was a field everywhere.

Mr. C. K. Durbin, speaking of irons, said that he understood the Denver company had introduced 3000 irons the past summer. A small Oklahoma central station which his company controlled, and which had just started day service, had introduced 60 electric irons in the last three months. In Sheridan, Wyo., (population 6000) 75 irons had been placed. Mr. Sewall said that in one case with 123 consumers, 117 irons had been placed on trial and 92 had been sold.

Mr. Putnam, of Denver, said that the advantage of placing the iron on trial was that it let the solicitor into the house, so that he could perhaps secure the introduction of other useful appliances. Mr. I. A. Hoy, of Leadville, said that since May 1, 1907, his company had placed 101 irons, of which 60 were paid for and 41 were loaned on a deposit. Mr. J. F. Vail said that in Pueblo the revenue amounted to about $6 per year per iron.

Mr. C. N. Stannard, of Denver, said that the average of those upon which they had kept records was 67 cents a month.

Mr. Monroe cited the case of one customer who formerly used gas irons and put in seven electric irons in July. The net increase in gas and electric bills combined for the month of August was $23.35. The net increase for September was $33.10. He paid 9 cents per kw-hour for energy used in the irons. The gas and electric company's revenue was therefore increased by the substitution of electric for gas irons and the customer was better satisfied.

ELECTRIC SIGNS.

The question was opened of getting electric sign business in small towns. Mr. C. K. Durbin said that it was hard work getting such signs in the smallest towns where his company controlled the central stations. In towns of 10,000 and over, such as Albuquerque, N. M., and Tucson, Ariz., it was easier. He used a flat rate, the signs being turned on a certain number of hours each night. The rate is calculated to give the company six cents per kw-hour. A question was asked as to the advisability of furnishing signs free to customers. Mr. R. P. Bache, manager of the Colorado Springs Electric Company, said that he was opposed to free signs because of his experience with this practice in eastern companies before he came to Colorado. He liked the plan which he found in effect at Colorado Springs much better. There the customer either pays cash for his sign or buys it on the installment plan.

Mr. C. N. Stannard thought that if a company went into the business of selling signs it ought to sell them. The customer who is likely to want the free sign or whose payment is scattered over a long period, is likely to be a man with poor credit, who may go under and leave the sign on the company's hands. He did, however, believe in doing wiring for show-window and outline lighting free, provided the contract was made for two years and the cost of construction was not above

the gross revenue which would be received under the contract the first three months. This concession undoubtedly brought in business which could not have been secured otherwise.

Billboard Lighting in Various Cities.

The electric lighting of billboards to make them valuable at night as well as during the daytime is now getting a good foothold and becoming recognized as a desirable thing by both billboard companies and by advertisers. Last year we published some account of the work begun at St. Louis in the lighting of billboards, both for advertising the central station company's own business and that paid for by the regular billboard advertisers.

FIG. 1.—BILLBOARDS NEAR NORTHWESTERN ELEVATED RAILROAD TERMINUS.

In Chicago, Kansas City and Indianapolis the Thomas Cusack Company, a billboard concern operating in those three cities, has begun to sell day and night billboard service, purchasing energy from the electric lighting companies and billing the advertising customer for the total cost of his billboard service plus the electric lighting feature. Some Gunning system billboards are also lighted in Chicago, the Gunning system buying its energy from the Commonwealth Edison Company. The Commonwealth Edison Company in Chicago gives service for billboards at the same rates as its sign lighting service and turns the electricity on and off at stipulated hours, maintaining a patrolman service for this purpose. As the number of hours' use per month is thus entirely under the control of the company, a flat rate is made, this flat rate being the equivalent of the company's regular lighting rates for the same number of hours' service per month. As this lighting rate is 15 cents per kw-hour for the first thirty hours' use of the maximum demand and 9 cents for all over that, the cost of a 16-cp lamp on a billboard lighted six hours per night or 180 hours per month would be about 88 cents per month.

FIG. 2.—BILLBOARD AT INTERSECTION OF TWO CHICAGO STREETS.

In most other places where billboard lighting has been begun, the central station company has sold electric lighting service direct to the billboard advertiser, independently of the billboard company, as such companies have as a rule been indifferent and in some cases even antagonistic to the electric lighting feature. The sentiment of billboard companies, however, has been rapidly changing about this, and they are now looking upon it more favorably, as it undoubtedly adds much to the total value of advertising to have billboards lighted at times when people are most likely to read them.

Fig. 1 shows a couple of lighted billboards across the street from the Wilson Avenue terminus of the Northwestern Elevated Railroad in Chicago. One of these signs is turned on and off by a flasher at intervals of about four seconds. The flasher feature undoubtedly attracts attention to a billboard, even more than to a sign, because of the large surface lighted up. Both of the billboards in Fig. 1 have dark letters on a white background. They are lighted with 16-cp incandescent lamps placed about 12 ins. apart in a metal trough painted white inside. The trough has a flat bottom which holds the lamp sockets. The sides are straight. Fig. 2 shows another Chicago billboard at Thirty-Fifth Street and Cottage Grove Avenue. This is over a store at the intersection of two streets where it can be seen for a considerable distance. This sign is also flashed. It is equipped with deep, conical reflectors.

FIG. 3.—BILLBOARD IN DENVER.

Fig. 3 shows a billboard on Sixteenth Street in Denver. In this city the Denver Gas & Electric Company contracts direct with the billboard advertiser for the lighting of the billboard. The company furnishes the lamps, wiring and trough in which the lamps are concealed. This is done under a two years' contract, where the cost of construction to the company will not exceed the revenue the billboard lighting brings in the first three months of its operation. The rate charged is a flat rate which is equivalent to the company's regular readiness-to-serve rate, figured for the number of hours the billboard is lighted per month. The company turns the lamps on and off, just as in the case of sign and show-window lighting, which is also largely taken at a flat rate. This readiness-to-serve rate is $1 service charge per month plus 15 cents per 16-cp lamp connected plus 5 cents per kw-hour for energy consumed, less a

FIG. 4.—BILLBOARD AT IMPORTANT JUNCTION STATION IN CHICAGO.

discount of 10 per cent if paid within ten days from date of bill. This makes the cost approximately 60 cents per 16-cp lamp per month if the board is lighted six hours per night, or 180 hours per month.

In Chicago, on an important junction station on the Metropolitan Railroad at Marshfield Avenue, a number of billboards are placed on the roofs of adjoining houses. One of these as

FIG. 5.—DENVER BILLBOARD BY DAY.

it appears by daylight is shown in Fig. 4. This illustrates the appearance of the trough in the daytime, showing how unobtrusive it is.

Fig. 5 is a view of a Denver billboard by day, showing the appearance of the troughs. On the billboards recently erected in Denver, however, the supports are not placed on the surface of the board, as in Fig. 5. The general form of the trough is semi-circular. Lamps in the trough are supported horizontally on weather-proof porcelain sockets. This arrangement appears to be not very satisfactory, however, as the socket supports frequently get bent so that the lamps project below the trough. Fig. 6. shows a billboard placed on top of a Denver garage which it advertises.

Besides billboards lighted with incandescent lamps in Chicago, experiments are being made with flaming arc lamps for this purpose, the most notable example being at Jackson Boulevard and Dearborn Street, in the heart of the business district. One 450-watt flaming arc is more than ample for 25 ft. of billboard. The arc lamps are fitted with metal guards or reflectors on the side toward the street, to prevent the light from blinding those looking toward the board. The flaming arc

FIG. 6.—BILLBOARD ON DENVER GARAGE.

lamp unquestionably offers a cheaper method of lighting a billboard than incandescents where as much as 50 ft. of board is to be lighted, so that two lamps can be placed in series on 110 volts.

The chief trouble to be avoided in using flaming arc lamps for billboard lighting is to to place them high enough above the board so that the glare of regular reflection from the paint will not interfere with the reading of what is on the board. Wherever the angle of the lamp to the board equals that from the observer's eye to the board, this trouble is sure to be serious, as the flaming arc lamp is such a powerful source of light. At present there seems to be no way of avoiding this trouble, save to hang the flaming arc lamp some distance above the top edge of the board.

In the incandescent system the chief defect at present is that too much light is thrown on the top of the board and not enough on the bottom, as is apparent in the illustrations. This contrast is great enough to interfere with the reading of billboards some distance away. Near by, it is not of so much importance. If the illumination could be distributed evenly over the board and light escaping in useless directions directed on the board, doubtless considerable saving could be made. It must not be understood from this that the electric lighting of billboards is not at the present time in a satisfactory condition from the advertiser's standpoint. It simply means that future developments may make it possible to reduce the cost of lighting a given amount of billboard, and so from the central station standpoint increase the amount of such business.

In Pittsburg the lighting of billboards has been gone into very extensively. Mr. G. G. O'Brien, who gives billboard service in that city, has made extensive use of electricity for illuminating his boards. In one case a board 300 ft. long has been lighted and flashed in a number of sections. Another board 200 ft. long is flashed in sections.

Grand Rapids, Mich., Electrical Situation.

By L. W. Bailey.

The ultimate success of the Grand Rapids-Muskegon Power Company in securing a new franchise in the city of Grand Rapids, Mich., marks the beginning of a new era in that city. The publicity campaign of the company was described in the Oct. 5 issue of the ELECTRICAL WORLD, and it won out by a pleasing majority at the polls. The franchise obtained, while a good one for the company, is one of the most favorable in the country for a city the size of Grand Rapids. It puts the rates for both lamps and motors far below the terms of the old franchise.

Following its campaign for a new franchise the company has continued its publicity policy in a campaign for new business. The advantages of electricity, particularly for lighting purposes, are emphasized in the newspaper advertisements, and the city is circularized carefully with both circulars and booklets. A page advertisement in the daily papers, run several times, sets forth a proposition for wiring a six-room house for $12, and then tells what can be done with a kilowatt-hour of electricity.

The city is preparing either to enlarge the capacity of its street lighting plant or to buy energy from the power company. However, the gas company is endeavoring to secure a contract for street lighting, and permission has been given to both concerns to place lamps on both a business and a residence street for demonstration purposes. The system of street lighting by the use of the tungsten lamps, as employed in Hartford, Conn., has been reported on favorably by an investigating committee and the power company will experiment with these lamps. A plan is also on foot to equip the lighting plant with machinery for operating the city pumping station.

The Canal Street Business Men's Association is figuring with the power company on a proposition to light that street from end to end in a manner which will give it the appellation of the "great red way." At present the street is lighted with festoons of incandescents strung thickly from curb to curb the whole length of the thoroughfare. The fire marshal has objected to this system, and one of the new type arc lamps may replace the incandescents, but at intervals of 120 ft.

The Grand Rapids East Side Power Company, which now obtains its power from a canal, may change its system to electricity. The city's flood protection plans include the filling of

the power canal. A station may be installed at the head of the canal and water taken through a sluiceway to operate an electric power plant. The central power plant, if erected, will cost about $10,000. Robert W. Irwin and Alexander Dodds represent the company in the matter.

A New Power Station Report.

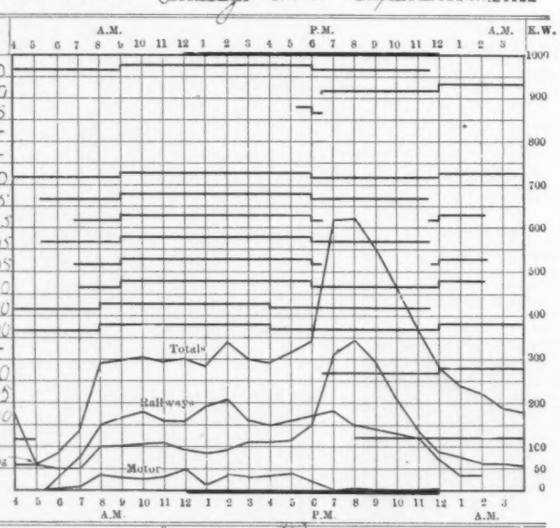
The accompanying form of power station report has been in use for the past six months by the Sheboygan Light, Power & Railway Company, and has also been adopted by the Milwaukee Northern Railway Company, both companies being under the management of Mr. Ernest Gonzenbach. Mr. Gonzenbach has been getting out power-station reports for the past 15 years and has always wanted something clear and concise by means of which he could read the story of the day at the power station without wading through a mess of figures. About a year ago Mr. Gonzenbach began to experiment, with the result that last spring he put into service the form of report shown herewith, which has so far been entirely satisfactory, and which has been pronounced satisfactory by everybody who has used it. The record is very simple, is easily read and can be understood at a glance. Possibly the only explanation required is the little break in the straight lines, indicating the runs of the various units. This little break in the straight line is put in to show the time when the men changed shifts. The amount of apparatus in operation during the hours of peak load can be seen at a glance, and it is very readily observed if any machine has been run too long after the peak was off or if it was started too late. The time of switching on and off the street lamps is also shown by the last straight line at the bottom. The load curves are obtained by reading watt-hour meters in the power station every hour. This has been found very practical and no extra trouble for the power-station force. The method of making up these curves is interesting. All of the charts and curves are made by the engineer in charge of the shift at the power station and they involve no labor of any kind at the office. The pads are accurately registered and a carbon copy sheet is put under the first leaf. The power-station engineer or his assistant then plots a curve every hour by making pencil points with an ordinary lead pencil. At the end of his shift he connects all the pencil points with a line. The engineer on the next shift does the same thing. This necessarily makes the sheet somewhat grimy, but the top sheet is kept by the power-station force for its own record. In this way the manager has a complete history of the power station in the most complete form available at all times. The load factor given is the percentage which the average load is of the maximum. The station factor is the percentage which the average load is of the total capacity of the station. The railway demand factor is the percentage the maximum railway load is of the station capacity, and the lighting demand factor is the corresponding figure for the lamp load.

SHEBOYGAN LIGHT, POWER & RAILWAY CO.

DAILY POWER STATION REPORT

DAY BEGINNING AT 4:00 A.M. Friday DAY OF Sept. 6 1907

Units	Hours Run
Engine A.C.Gen. 1	19:30
" " " 2	9:30
Engine No. 3	1:15
" 4-D.C.Gen. 4	
Engine Exciter	
Motor "	24:00
Syn. Motor 29	18:05
" " 7	14:05
D.C.Gen. 3	18:05
D.C.Gen. 5	14:05
Booster	19:10
Boiler No. 1	19:30
" " 2	24:00
" " 3	
" " 4	9:40
Motor Power	18:35
Street Lighting	10:00
	Lighting



Output		
City & Falls Railway	1810	K.W.-Hours
Plymouth Railway	1040	" "
Total Railway	2850	" "
Motor Power	345	" "
Commercial Lighting	2536	" "
Street Arc Lighting	456	" "
Total Output	6690	" "

Coal Consumed 55 674 163/4 Lbs.

Pounds Coal per K.W.-Hour 5.76

Load Factor (ave./max.) 44.3% Station factor = 18.5% Ry. demand factor = 79%

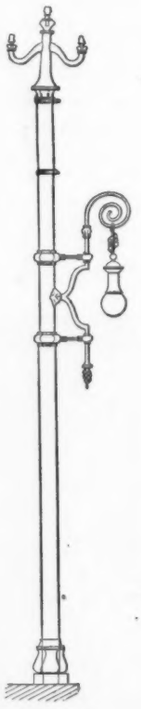
Remarks: Light demand factor = 41.6%

Chief Engineer

POWER STATION REPORT BLANK.

Special Street Lighting in Denver.

Special plans have been completed for the lighting of Fifteenth Street, Denver. Sixteenth Street, the most important thoroughfare of the city, has been lighted by arc lamps placed on special ornamental poles for some time past. Pictures of the pole used on Sixteenth Street, Denver, were published in the Electrical World of April 13, 1907. The poles used on Sixteenth Street are of very heavy cast iron and were designed to be used for supporting both trolley, span and feed wires and arc lamps. The new design for Fifteenth Street, made by Art Commissioner Henry Reed, contemplates the use of a special bracket on standard street railway steel tubular poles. This design is illustrated herewith. Along each block will be placed eight 6.6-ampere alternating-current arc lamps. Eleven blocks will be thus equipped.



COMBINATION RAILWAY AND LIGHTING POLE.

Service Supervisor Work in the Denver Gas & Electric Company.

The recent convention of the Colorado Electric Light, Power & Railway Association, at Denver, Sept. 18 to 20, brought out some interesting and valuable experiences of the Denver Gas & Electric Company in increasing the revenue from its customers. The subject was opened by a paper on "Business Building by Commercial Departments," by George E. Putnam, of the new business department of the Denver Gas & Electric Company, which was followed by a general discussion, in which Mr. C. N. Stannard, secretary of the company, gave additional information.

The company has in the past year been giving special attention to increasing the gas and electric consumption of its customers. For this purpose, in 1906, seven service supervisors were appointed from among the men in the new business department. It was the duty of these men to secure, if possible, increased revenue from consumers. The regular district solicitors kept away from customers upon whom the service supervisors were working. These service supervisors appeared first to the customer as men looking after the quality of the service rendered by the company, to see wherein improvements could be made which would give the customer better satisfaction for the money expended. In straightening out any little troubles the customer might have, these service supervisors would get an entrance to the customers' premises and become acquainted, so that the way would be open for the supervisor to introduce new appliances. Mr. Stannard stated that when these service supervisors were started in their work of getting more business from customers he almost felt sorry for the men, because he thought that they were undertaking a very difficult task, in which they might not be able to show the results expected by the higher officers of the company. The results, however, have been fine and exceed all expectations. The added business is lucrative because it involves no cost of construction, as the lines and meters are already in place.

The actual results obtained were shown by figures given for a period of ten months with seven service supervisors at work. Each one of the men was given a list of 300 residences to visit. After a period of about 3⅓ months, a second list of 300 houses per man was selected. At the end of the second 3⅓ months another set of 300 houses per man was assigned. At the end of ten months, therefore, the seven service supervisors had been assigned in the three installments, 6300 residences. The work was confined entirely to residences, because these seemed the most promising. The men worked both the electric and the gas fields. Results for the first ten months showed 39 per cent gain in the kilowatt-hour consumption of the residences using electricity worked upon over the corresponding period of the previous year. The gross revenue from this source was increased 28 per cent. The gas consumed by the customers worked upon was increased 44 per cent, and the revenue 27 per cent. The increase in revenue in the first instance amounted to $10,307, and in the latter instance, $10,892 for a period of ten months.

When it is considered that the business brought in by service supervisors involves no construction costs, it will be seen that it doubtless yields the highest returns to the company for the amount spent in soliciting it. The successful experience of the Denver Gas & Electric Company with its service supervisors has already resulted in a considerable change in the organization of its new-business force. Whereas, there were formerly 14 district solicitors, each having an assistant, and a few service supervisors and specialists in various branches of the work, there are now 14 district solicitors, no assistant district solicitors, 14 service supervisors, and specialists in motor work, show-window, sign and display lighting. In the combined gas and electric business, it is approximated that for each dollar spent in a year for solicitation, the increase in gross revenue for that year will be about $2. In the electric end of the business alone, some of the classes of business giving the best returns for solicitation will yield as high as $3 increased yearly revenue for each dollar spent within the year for solicitation.

How effectively a well-organized new-business department such as that of the Denver company can introduce a new device is shown by the rapidity with which electric flatirons have been put in service last summer. Until last spring the company had not taken up the work of pushing the electric iron to any extent. Since last spring over 3000 irons have been purchased and put in service by customers. The average increase in revenue due to the use of these irons so far has been about 67 cents per month per customer. Irons are sold at $5 each. The Pacific iron has been the one most extensively used, although a large number of American and Simplex irons have also been put out.

The service supervisors' work, although confined heretofore to the residence district, will probably be extended to downtown districts.

In connection with service supervisor work, a knowledge of illuminating engineering is of considerable importance to the service supervisor, in order that he may win the customers' confidence and pave the way for the introduction of new devices by showing the customer how he can get better results for the money he is spending for light. The Denver Gas & Electric Company was one of the first to recognize this fact and act upon it in a practical way. In the fall of 1905, a corps of six men was selected in the new-business department to become trained specialists in illuminating engineering. Mr. J. R. Cravath, western editor of the ELECTRICAL WORLD, was retained as consulting illuminating engineer to guide the study and training of these men and advise with them by correspondence on practical problems in illumination coming up in the company's work. Since then the illuminating engineering corps has been a recognized part of the company's new-business department. On account of the removal of a number of the original men to other companies, there have been many changes in the corps, but it has always kept up its work and at the present time holds regular weekly meetings to discuss illuminating-engineering problems.

A Merchant's Opinion of Gas Lighting.

The leading clothing merchant in a prosperous Western city, when talking recently of the possibility of gas lighting in his new store, remarked, "I figure the fly specks begin to collect the minute a man adopts gas for store lighting." He spoke figuratively, of course, but very much to the point, as he expressed the effect on the public as to general inferior standing and unprogressiveness of the stores which cling to antiquated, ill-smelling, stock ruining and troublesome gas or gasoline lighting.

Electric Railway Advertising.

At the meeting last week of the American Street and Interurban Railway Association at Atlantic City, two papers were presented on the subject of electric railway publicity and advertising. One of these was by Mr. J. Harvey White, publicity manager of the Boston Elevated Railway Company, and dealt more particularly with relations, with the newspaper press in connection with the supply of information relating to the railway having an interest to the general public. The publicity department of the Boston Elevated was organized for the purpose of furnishing a central source of supply to which newspaper men could go for information relating to accidents, complaints against service, construction, finance, etc. To this end, the office keeps on file statistics, etc., and when the occasion arises calls upon any officer of the company for information.

The second paper was by Mr. A. W. Warnock, general passenger agent of the Twin City Rapid Transit Company of Minneapolis and St. Paul, Minn., who described the means adopted by his company for furthering the increase of passen-

ger traffic. This company has developed a summer residence district and excursion amusement resort at Lake Minnetonka, 18 miles from Minneapolis, where it owns about a dozen steam vessels on the lake. The attractions at this place during the summer season are constantly kept before the public by various advertising means, and traffic to other lakes, parks, etc., reached by the lines of the company, is similarly promoted. The paper describes in detail the various methods used in obtaining publicity.

Commercial Progress in Seattle Central Station Work.

During the past summer the Seattle Electric Company has been putting out 250 to 300 electric flatirons per month on trial, and not more than 8 per cent have been returned. To introduce the use of electric heating pads each of the hospitals in the city was presented with a pad, and also some ten prominent physicians, calling attention to the advantage of such a pad over the ordinary hot-water bottle, and requesting that the pad be made useful. The company also informed the doctors that it would welcome their opinion of the merits of the pad when they had had opportunity to observe its work. In almost every instance gratifying replies were received.

In connection with the display of heating devices many have been shown in actual operation in the show windows of the company, such as the coffee percolator with boiling coffee, teapot steaming, cereal cooker in service, chafing dish at work, bucket boiling potatoes, griddle frying pancakes, broiler cooking steak, and so on. These actual working displays have materially helped in the sales, and the result has been an increased non-peak output. In the last two years the Seattle Electric Company has sold over 4000 flatirons, besides many small heating devices, and a considerable number of the larger cooking utensils.

The city of Seattle has just let the largest contract for regrading in its history, namely, the taking down of Denny Hill. This work will cost over $1,000,000, and will be largely done by the hydraulic process. A large electric motor installation will be used for pumping the necessary water from Puget Sound.

Financial Methods in Floating Electric Light Securities.

By E. H. Mather.

It certainly appears as though financial methods detrimental to the future welfare of electric light properties were becoming more common at this, the most dangerous period, for such practice, within the history of the electric light industry. The practice which deserves criticism is the over-capitalization of electric companies followed by the publication of misleading statements of earnings and expenses. The former, although under the ban at the present time, is unjust only when coupled with unreasonably large dividends, or other profits, taken from the business, but when followed by the latter immediately becomes a matter of much concern, and the practice will sooner or later injure the innocent stockholders as well as the guilty promoters.

The public is well aware that public service corporations have in many instances abused the privileges given them, and it is quick to suspect that any and all such corporations are securing from the public more than that to which they are justly entitled.

There is, as is well recognized, a general feeling that electric light companies, as well as other public utility corporations, have been and still are charging too high rates for the service rendered. As a result of this feeling, the public is looking for and adopting methods to prevent this practice.

The operating managers, quickly seeing the importance of checking this move, have set about to give the public better service, and in many cases, lower rates. They are clearly showing that better service and lower rates cannot, generally speaking, be secured by municipal ownership, the remedy commonly adopted by municipalities for the evils, real or imaginary as they may be, that may exist. Of late, more attention has been given to the individual requirements of customers, their wants have been anticipated, complaints have been received cheerfully and promptly attended to by young men of ability and diplomacy; they have been educated to a much wider field for the use of electricity, and able solicitors have been sent throughout the territory. Since these representatives are to the public the personnel of the companies, the customers have come into much closer touch with many corporations supplying electricity; all of which has worked to the great advantage of both the producers and consumers.

While the operating managers have been striving to secure public confidence, the financial managers have in many cases adopted methods of financing which will more than counteract the benefits secured by the operating departments. It is not uncommon for a local electric light company to be purchased by outside parties, and then bonded for a sum sufficient to pay practically, if not quite, the entire cost of the property to the new owners, and also make all necessary improvements and extensions for several years to come. In addition, an issue of stock is brought out which not infrequently equals the bond issue, and represents but very little, if any, cash investment. While this is beyond the bounds of conservative financing and while the public may wonder at such an increased capitalization, it can be shown that the value in the original stock has simply been transferred to the new issue of bonds, leaving under them practically no equity.

To assist in floating such issues of bonds, statements of earnings and expenses have been published. These have frequently shown a reasonable increase in gross earnings, but most extraordinary increases in net earnings. In some cases the net earnings as shown have been sufficient to pay the interest on all the outstanding bonds and from five to ten per cent on the total issue of stock, which is practically all water.

What is the result? An impression is made on the minds of the local public that there are enormous profits in the electric light business when properly conducted, and therefore the rates must be altogether too high, even though they in fact be comparatively low. The public becomes dissatisfied, and efforts are made to secure lower rates by one method or another.

Any electric light company which shows net earnings of 15 to 20 per cent on the entire cost of the property is, in my opinion, either charging too high rates or its statements are not entirely correct. Cost in such cases as these usually includes a good profit on the actual cost of the entire property to the original stockholders.

An analysis of the published statements of some of these companies will often clearly show that the accounts were kept with a view of making as good statements as possible. The operating expenses have been reduced to the lowest amount, and in some cases the construction accounts have carried a portion of the expense that properly belonged to the operating accounts, and depreciation has frequently been lost sight of entirely. Such statements have been prepared solely for the purpose of inducing the investing public to purchase the bonds of the companies.

To one familiar with the electric light business, it is apparent that the financial managers or promoters of companies making such statements have been rather over ambitious, and in preparing such statements as are often seen in circulars describing issues of bonds, have told the truth and nothing but the truth, but not quite the whole truth.

On such statements of earnings and expenses, bankers are induced to purchase the bonds which are retailed to their clients as first-class securities, and so long as the interest is paid and such statements are published, the bonds will be so considered. If, however, the net earnings are decreased by forced reduction in rates caused by legislative action or by competition with competing companies or municipal plants or by dull times or by heavy replacement expenses caused by depreciation which was not provided for, this now desirable class of securities will not stand in good favor with the investing public.

Any practice that educates the general public to believe that the profits in the electric light business are greater than they actually are, should be strongly condemned by all conservative electric light managers, for it is suicidal to the business.

The over-capitalization of electric light properties, followed by the publication of incomplete and misleading statements of net earnings, is an injustice to the bondholders, who are led to believe they have purchased securities with a large equity under them, and to the stockholders in companies conservatively financed, and if continued will lead to one or more of the following conditions:

1. Municipal ownership, which with few exceptions is of no benefit to the general public.
2. Unprofitable low rates caused by competition or legislative action.
3. Over-stringent state laws which will prevent even reasonable capitalization.
4. Loss of confidence by investors in electric light securities.

Better Lighting for Chicago Business Streets.

Arrangements have been made for the improvement of a street in the heart of Chicago's down-town district, which will very likely result in improved lighting for all of the streets in that district. The Dearborn Street Improvement Association has been formed by property owners to pay for the improved paving and lighting of Dearborn Street for a distance of about nine blocks from Van Buren Street north to the river. At a meeting of Dearborn Street property owners held Oct. 22, owners of over half of the frontage involved pledged their support to the lighting scheme which is to be carried out immediately. Although no details have been worked out, it is generally understood that ornamental boulevard posts at frequent intervals, with incandescent lamps, will be used. Mr. J. R. Cravath is consulting illuminating engineer for the association. The western offices of the ELECTRICAL WORLD are on Dearborn Street. Other streets are now organizing associations with a similar purpose.

LETTER TO THE EDITORS.

Calculating Show-Window Illumination.

To the Editors of Electrical World:

SIRS:—We find that a very curious and inexcusable error slipped into the article on the "Engineering of Show-Window Illumination" by the writers which appeared in the ELECTRICAL WORLD of Sept. 7, 1907. In regard to the illumination curve necessary evenly to illuminate any show window, the writers in effect stated that this curve should be plotted by taking the square roots of the distances from the lamps to the points in the window to be illuminated; whereas, as must be apparent to all engineers, the correct method is to take the square of these distances. This error of employing square roots instead of squares, of course, will make considerable change in the forms of the ideal distribution curves given in that article. As to the selection of reflectors, however, the reflectors commercially available are so far from giving the ideal distribution that in the majority of cases the selection of reflectors given in the article would not be changed.

The writers will not attempt to explain the psychological reasons why two apparently sane engineers, who have frequently used this method and used it correctly in times past, should allow such a mathematical twist to get into a published article. They can only apologize to any who may have been led astray by the error.

CHICAGO, ILL. J. R. CRAVATH.
NEW YORK, N. Y. V. R. LANSINGH.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Turbo-Dynamos.—The conclusion of the illustrated article on turbo-alternators and turbo-dynamos of Brown-Boveri & Company. The field-core system adopted for the direct-current

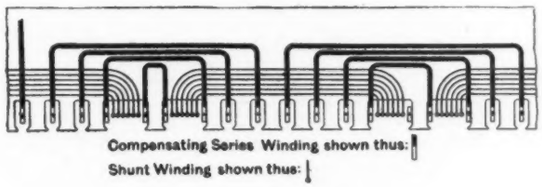


FIG. 1.—WINDING DIAGRAM.

machines is shown in Fig. 1. The field structure, which is practically smooth all around, is very similar to that of the stator of an induction motor, it being built up of stampings provided with slots spaced around the inner periphery. There are two sizes of slot, into which the main windings and compensating windings are respectively placed. The main windings consist of former-wound coils, and they are placed in the larger slots, into which they are secured by means of metal wedges; the compensating windings consist of copper strip, placed edgewise in the smaller slots, and also secured therein by wedges. The field distribution thus obtained is such that perfectly satisfactory commutation is obtained at all loads with a fixed position of the brushes. This special type of machine is built in all sizes from 100 to 1800-kw individual output.—Lond. *Electrician,* Sept. 27.

Single-Phase Commutator Motors.—J. BETHENOD.—A mathematical article on the mean losses due to commutation during the period of starting single-phase commutator motors.—*L'Eclairage Electrique,* Aug. 31.

Lamps and Lighting.

Determination of Mean Horizontal Cp.—E. P. HYDE AND F. E. CADY.—With reference to the paper of Uppenborn, which is liable to discredit the determination of mean horizontal cp by the convenient method of rotating the lamp about its axis of figure, the authors have again carefully tested this method, which is the one in almost universal use in this country. Uppenborn attributed the errors of this method found by him to the distortion of the filament by the rotation. The present authors found that the maximum error observed, due to a bending of the filament, was not in any case greater than 1.5 per cent, provided the filament did not touch the bulb, even though the filament was bent so as almost to touch the bulb. The speed of rotation necessary to force the filament against the bulb was not less than 600 r. p. m., except for special 32-cp, 220-volt lamps without anchors, and for these it was about 425 r. p. m. For most common types of lamps the speed would be much higher than 600 r. p. m. and it is probable that for some types a rupture of the filament would occur before the filament would touch the bulb. When the filament touches the bulb, changes in candlepower of as much as 6 or 7 per cent may take place, but as these large changes are always accompanied by relatively large changes in resistance, it is probable that they are due to a cooling of the filament owing to the contact with the glass. As to the effect of flicker, the authors state that for many of the common types of lamps in use in the United States the error due to flicker at a speed of 300 or 400 r. p. m. is probably not very great with most experienced observers, and since the error due to bending is quite small at these speeds the ro-

tating lamp method is convenient and reliable in commercial testing. For the photometry of lamps having an annoying flicker, or for the more accurate photometric test of lamps with a moderate flicker, the simple experiment of employing an auxiliary mirror as described in detail in their former paper will be found very satisfactory.—*Bulletin, Bureau of Standards,* Vol. III, No. 3, August.

Power.

Electric Power in Metallurgical Works.—A fully illustrated description of the electric installation of the Burbacherhütte in Germany, where power is used for driving the rolling mills, and a great many other purposes. There are in the whole about 300 motors with an aggregate rating of 3000 hp, while 4000 incandescent lamps and 300 arc lamps serve for lighting the plant. The old power plant contains three gas engines driven by blast-furnace gases. Each is coupled to a 240-volt, 420-kw, direct-current dynamo, so that this work has a total rating of 1260 kw; it feeds energy to a 240-volt, two-wire system. With the increasing use of electric power for different purposes it became necessary to erect a second power plant. This contains a gas engine operated by coke-oven gas and driving a 980-kw, 2x240-volt, double-commutator dynamo. This new plant also contains a 1250-hp steam turbine driving two turbo generators, each of 420 kw, which also supply energy to the 2x240-volt, three-wire network to greater distances from the plant. The electric installation of the rolling mill is described and illustrated.—*Elek. Kraftbet. u. Bahnen,* July 24.

Electric Power for Tunnel Construction.—In the construction of the Tauern tunnel which will make connection between Salzburg and Kärnten, and after the completion of which the new large railroads in the Alps can begin full operation, electric energy is used to a very large extent. Near the southern end of the tunnel a water power of 1100 hp has been developed, the electrical energy being transmitted to the entrance of the tunnel where three motors of a total rating of 540 hp serve for driving 3 blowers for ventilating the tunnel. At the other end of the tunnel another station has been erected. Both hydraulic and electric drills are used. The hauling is done electrically; the lighting is carried out exclusively by electric lamps. In the whole there are installed on both sides of the tunnel machines and transformers of 7500 hp, of which 1900 hp are simultaneously used. Direct-current machines of 550 volts and three-phase machines of 110, 220, 350, 2000 and 5000 volts are installed. After completion of the tunnel the stations will be used for lighting and industrial purposes.—*Elek. Zeit.,* Sept. 26.

Inclined Electric Lift.—An illustrated description of a peculiar form of inclined electric lift recently installed in a hotel in St. Moritz in Switzerland, in which the car always hangs vertically although the inclination of the track upon which the trolleys run is variable. Push-button control is employed.—Lond. *Elec. Eng'ing,* Sept. 26.

Electric Percussion Rock Drills.—L. Brinkmann.—Illustrated descriptions of various types of that drill. The drills dealt with include examples of solenoid drills, motor-driven, spring drills, pneumatically cushioned and electro-pneumatic drills. Figures are given showing the superiority of electric over air drills in the matter of efficiency, and a table compares the weights and efficiencies of the types described. The class of work and conditions for which each form is most suited are discussed.—*Elek. Kraftbet. u. Bahnen,* Aug. 14 and 24; Lond. *Elec. Eng'ing,* Oct. 3.

Lifting Electromagnets.—C. R. Benjamin.—An illustrated article on the construction of electromagnets for lifting and handling materials of iron, etc.—*Cassier's Magazine,* October.

Wear and Tear of Turbines.—J. Dalemont.—The conclusion of his serial on the wear and tear of hydraulic turbines. The author deals with Pelton wheels and then summarizes the causes of abnormal wear and tear.—*L'Eclairage Electrique,* Aug. 31.

Traction.

Steam and Electric Traction for High-Speed Railroads.—R. Rinkel.—An article in which the author first shows that the capacity of steam locomotives cannot be further increased for higher speeds without necessitating reconstruction of the roadbed under present German conditions. To increase the speed on the present roadbed electric traction offers the only solution. A comparison is made of the operating cost for steam and electric traction, and the final conclusion is that in addition to the increased speed the electric operation which does not necessitate strengthening the roadbed and track will be cheaper than the present steam operation of express trains even if the electrical energy must be generated from coal. It is assumed, however, that large power plants not below 10,000 kw are built and that not more is charged for the coal than is charged at present for the coal used on locomotives on Prussian state railways. "If we consider all circumstances it does not seem to be too optimistic to say that electric high-speed traction with trains of 9 or 10 cars with a speed of 72 miles per hour will be about 40 per cent cheaper than steam traction with two steam locomotives. With one steam locomotive such trains cannot be operated on the present strongest roadbed of Germany." It is strongly recommended to give electric traction a trial in the Westphalia industrial district on the road from Hamm to Düsseldorf of a length of 66 miles.—*Elek. Kraftbet. u. Bahnen,* Aug. 3 and 14.

Tramway Brake.—A note on a new tramway brake which is being experimented with on the Leeds Tramways. It is a track brake of the magnetic type, in which the drag of the magnetic shoe is employed to apply other track-brake shoes, instead of wheel brakes. In the experimental car the wheel brakes are entirely dispensed with.—Lond. *Elec. Eng'ing,* Oct. 3.

Installations, Systems and Appliances.

Berlin Electricity Works.—K. Wilkens.—A very full summary of the equipment of the Berlin electricity works in the beginning of 1907. Negotiations between the company and the municipality of Berlin have led to an understanding according to which the output of the works is no longer restricted and the works will be obliged to satisfy any demand for electric energy within the city limits. The company has the right to use the public streets and squares for placing its cables until the city makes use of the privilege of taking over the works. Nothing has been changed in the former arrangement as to taxes, but the electricity works will have to increase the rate of amortization if they should be allowed to operate the works after the year 1915. Further, if the company wants to change the charge for motor service it must first get permission from the city. There are 14 stations, and during the year 1906 there were generated 182,808,881 kw-hours by means of generators of 81,566 kw rating. At the end of 1906 the connections for lamps were 52,885 kw and those for motors 68,494 kw without taking the electric railways into consideration. The total energy sold during 1906 was 138,140,613 kw-hours, including that for traction. A maximum load of 75,982 kw was reached in December, 1906. At this time a capital of $27,000,000 had been invested, of which already $6,700,000 had been written off. It is estimated that the central stations will have to double their equipment during the next 10 years to satisfy the requirements, and that a capital of about $10,000,000 will be required for this. Originally each part of the city had a direct-current generating station, but this soon became unfeasible on account of the expense for the ground and difficulty of water supply and coal transport, etc. For this reason the scheme is now to transmit energy from a few very large stations by means of high-tension, three-phase currents to substations distributed over the whole city. In the substations the three-phase currents are changed to direct current which is distributed at 2x220 volts for lighting and at 550 for traction. The old direct-current central stations have a 2x110-volt net-work. While the inner city is supplied with direct current, the suburbs get three-phase currents at 3x220 volts, and consumers with large motor connections get in some cases a secondary voltage of 3x500. The different suburbs have a closed secondary net-work which is mostly placed underground. All the primary feeders are underground. The high-tension, three-phase currents are changed to low-tension, three-phase currents by means of transformers

placed in columns which also serve for advertisements, signs, etc. There are now three high-tension stations supplying three-phase currents at 3x6000 volts; one of them also supplies currents at 3 x 10,500 volts. The author then discusses the arrangements provided for coal transport and the boiler plants. The steam engines have increased in size with the size of the work, but more recently steam turbines are exclusively used. The saving of space which is thereby rendered possible became evident at the station in Moabit where at the place occupied before by a reciprocating engine of 1830 kw it became possible to place 3 steam turbines with a total rating of 13,000 kw. The 3000-kw steam turbines of the Allgem. Elek. Ges. consume 6.0 kg of steam per kw-hour at a steam temperature of 300 degrees C. For a steam temperature of 350 degrees C. this is reduced to 5.5 kg per kw-hour; the 3000-hp reciprocating steam engine consumes at 300 degrees C. 6.7 kg of steam per kw-hour. The article is to be continued.—*Elek. Zeit.*, Oct. 3.

Short-Circuit Brake.—M. KALLMANN.—The author has formerly made manifold applications of the "ballast" resistance used in the Nernst lamp, consisting of a resistor with high positive temperature coefficient, for instance, iron. As recently described in the Digest, he applied such resistors to the automatic starting of motors. He now uses them for automatic short-circuit braking. The advantage of his automatic method is that one gets independent of the speed of braking. Fig. 2

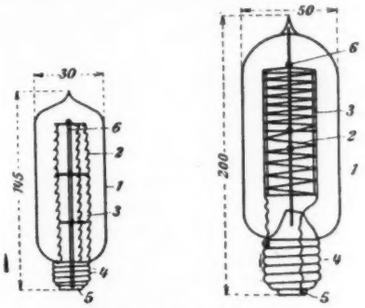
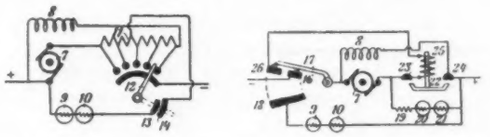


FIG. 2.—RESISTORS.

shows a small and a large resistor of this type which is called by him a variation resistor. The dimensions in the diagram represent millimeters. The diagram at the left hand shows a small variation resistor consisting of various pairs of iron spirals, two of which are 1/10 mm thick and are heated to red heat by a current of 1 ampere. A resistor of this type consumes about 70 volts at 2 amperes, that is, 140 watts. When the current increases by 20 per cent the e. m. f. varies from 10 to 70 volts. A larger resistor is shown in the hight-hand diagram in which a bunch of thin iron wires is wound around and fastened to the frame 3. With a current of 10 amperes it consumes from 100 to 200 volts, or from 1 to 2 kw. The resistance when cold is 1 ohm, at red heat 10 ohms. The "inertia" is quite different for the two sizes; the smaller resistor becomes red hot in about 1/10 second after having been connected to full voltage while the large resistor becomes red hot in 1 second. According to the purpose for which the resistor is to be used the size must be chosen. The resistance is very low when cold so that in the first moment after closing the circuit there is a strong rush of current. If necessary, this rush of current is diminished by connecting an ordinary constant resistor of nickeline wire in series with the iron resistor in order to get the original value of both resistances sufficiently high. This rush of current, however, lasts only for a short time, and when red hot the resistance increases to about 5 or 10 times the value in a cold state. The resistors then rapidly cool off with the rapidly decreasing armature voltage of the motor which is being braked, the resistance decreasing to almost zero when the motor comes to rest. An arrangement for hand-braking is shown in Fig. 3, where 7 is a shunt-wound motor with the field coils 8. After disconnecting the starting resistor 11 by means of the lever 12, and after disconnecting from the net-work, the armature of the motor is connected in series with the variation resistor 9 and 10, and part of the starting resistor 11 when the lever bridges the contacts 13 and 14. Fig. 4 shows an automatic braking arrangement. When the lever 17 bridges the contacts 26 and 16, the motor 7 is connected to the net-work in series with the nickeline resistor 19 and the variation resistors 20 and 21. The winding of the starting relay 25 is in this position in shunt with the armature of the motor. When the motor is connected to the circuit the relay armature 22 is attracted and makes contact at 23 and 24, whereby the starting



FIGS. 3 AND 4.—DIAGRAMS OF HAND AND AUTOMATIC BRAKING ARRANGEMENTS.

resistor is disconnected and the motor is started. For braking, the lever 17 interrupts the connection with the line and makes contact with 18, whereby the motor is connected in series with the braking resistors 9 and 10, and the resistors 19, 20 and 21, because the contacts 23 and 24 of the relay armature are simultaneously opened. Several other arrangements are shown, and the application to series motors and to three-phase motors is also discussed.—*Elek. Zeit.*, Sept. 26.

Liquid Starter.—An illustrated description of a liquid starter of English make which has been designed to overcome the difficulties sometimes experienced in wire starters in connection with the no-volt release arrangement, possibility of starting-up too quickly, heating through starting too slowly, and also separately exciting the motor field, irrespective of the resistance in the armature circuit. The starter is totally enclosed in a wooden case, with the starting handle projecting at one side. On turning the starting arm, the plunger is lowered through the liquid resistor, and a weighted magnet-shoe fixed in a slide, is lifted, the raising of the latter immediately allowing the shunt switch to drop by its own weight before the plunger reaches the liquid, thus completing the shunt circuit before the armature circuit is formed. The plunger is fixed to a wooden float of a slightly smaller diameter than the jar containing the liquid, compelling it to displace the latter before sinking, and therefore making it impossible for the armature circuit to be completed too rapidly. The plunger reaches the contact at the bottom of the jar before the magnet-shoe reaches the top of the slide, which then at once cuts out the liquid resistor. This weighted magnet-shoe is held up by means of a magnet coil (in series with the shunt circuit), so that the moment the main switch is opened the coil is demagnetized, allowing the magnet-shoe to fall by gravity, the weight of the magnet-shoe at the same time allowing it to draw up the plunger to the off position. A resistor is inserted in the shunt circuit (which comes into play automatically as soon as the main switch is opened) to deal with the "extra" e. m. f. The overload release is operated by a solenoid device. "The liquid used is fireproof, and, unlike acids or soda, has very little effect on metals." These starters are thought to be specially useful for motor hiring schemes as only four sizes are required for dealing with motors up to 30 hp. The resistor solution is specially graded for any given hp and can be altered or renewed in a few minutes at the cost of a few cents.—Lond. *Electrical Review*, Oct. 4.

Wires, Wiring and Conduits.

Alternating-Current Cables.—C. BREITFELD.—Roessler has shown that for a clear insight into the phenomena in alternating-current cables and for the practical calculation of all cable problems two quantities are of decisive importance, namely, the apparent resistances of the short-circuited and the open cable. The present author shows how to get simple formulas for such calculations. If the no-load and the short-circuit resistance of an alternating-current cable for any short length is determined by measurement, these resistances may be easily calculated for other lengths.—*Elek. u. Masch.*, Sept. 15.

Selection of Cables.—R. Goetzke.—For an electric distributing system there is always a certain cross-section of cable for which the sum of interest and amortization of first installation, cost of maintenance and cost of energy lost in the cable is a minimum. The author gives simple formulas for finding this commercially most favorable cross-section.—*Elek. Kraftbetr. u. Bahnen,* Aug. 3.

Electrophysics and Magnetism.

Ratio of the Electromagnetic to the Electrostatic Unit of Electricity.—E. B. Rosa and N. E. Dorsey.—The first part of a very long account of a new and most careful redetermination of the ratio of the electro-magnetic to the electrostatic unit of electricity. The authors believe the condenser method to be the best one known at present, the ratio of the units being derived from the ratio of the electrostatic to the electromagnetic capacity of a condenser. By this method the ratio is determined in terms of a resistance, but inasmuch as the ratio of the units is equal to the square root of the ratio of the capacities, the uncertainty due to an error in a value of the ohm is divided by 2 so that if an uncertainty of 2 parts in 5000 in the value of the International ohm is admitted, an uncertainty of only 1 part in 5000 is involved in the ratio of the electrostatic to the electromagnetic units. The present installment of 110 pages deals with the determination of the electrostatic capacity.—*Bulletin, Bureau of Standards,* Vol. III, No. 3, August.

Electric Sparks.—H. Barkhausen.—A spark discharge is simply a special case of an alternating-current arc, and on this basis the author gives a simple theory of spark discharges. —*Phys. Zeit.,* Oct. 1.

Units, Measurements and Instruments.

Universal Shunt-Box.—J. K. A. W. Salomonson.—A description of an improved universal shunt-box which not only allows a definite fraction of the current which is to be measured to be sent through the galvanometer but also enables one to adjust the total resistance of the shunt-box so that it is neither too large nor too small compared with a galvanometer resistance. It may therefore be used with any galvanometer. The arrangement is indicated in Fig. 5, which shows the ordinary

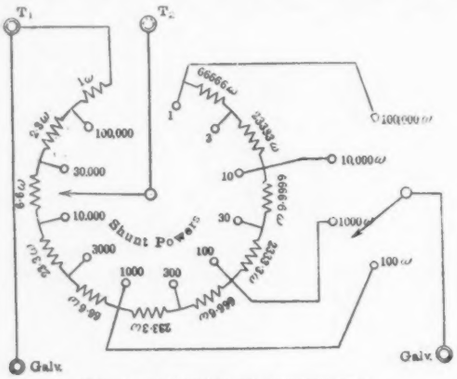


FIG. 5.—DIAGRAM OF SHUNT BOX.

universal shunt-box with a dial switch to alter the shunting power and with a second dial switch, permitting part of the resistance to be cut off from the galvanometer circuit, so as to reduce its total resistance. In the shunt box the total resistance amounts to 100,000 ohms. The eleven shunt powers are 1, 3, 10, 30, 100, 300, 1000, 3000, 10,000, 30,000 and 100,000. By means of the right-hand dial switch the total resistance can be reduced from 100,000 ohms to 10,000, 1000 or 100 ohms. If the box is used with one of the lower resistances, the shunt powers are reduced in the same proportion. The number of the useful shunt powers is, of course, also modified when the right-hand pointer does not point to the largest resistance. With 10,000 ohms nine-shunt powers are available, with 1000 ohms seven, with 100 ohms there are five shunt powers left. This modified universal shunt is particularly useful with moving-coil instruments, as it allows the absolute sensitiveness as well as the damping to be modified. Every galvanometer of this kind provided with it can be used with a periodic or an aperiodic movement of the coil. A critical damping can always be obtained, but necessitates the introduction of a suitable additional resistance, the amount of which depends on the external resistance.—Lond. *Electrician,* Sept. 27.

Alternating-Current Relays.—R. David and K. Simons.—The authors first give a brief calculation of the torque which is exerted by two alternating-currents differing in phase, on a disc as in the well-known Ferraris experiment. They then discuss the possibility of devising a relay on this principle. They deal with different methods of obtaining electrically a torque which is, up to the beginning of motion, proportional to the square of the current or to the voltage or to the product of current and voltage. They then discuss the possibility of devising relays for various purposes by combining such electric torques with mechanical torques.—*Elek. Zeit.,* Sept. 26.

The Arc Lamp for Measuring Purposes.—C. Heinke.—If a direct-current arc lamp with two homogeneous electrodes is shunted by a capacity and a smaller self induction, pure alternating currents of high frequency are generated automatically and continuously in the latter circuit. The author shows that for this reason the arc represents a valuable and convenient means for testing purposes in alternating-current engineering. It is specially suitable for measuring coefficients of self-induction and capacities. A number of arrangements for this purpose are described and explained by numerical examples.—*Elek. Zeit.,* Sept. 19.

Compensation Instrument.—C. Paulus.—An illustrated description of the technical compensation instrument of the European Weston Instrument Company.—*Elek. u. Masch.,* Sept. 29.

Single-Phase Meters.—A note on a British patent of the Compagnie de Construction Electrique. In meters of the induction type for single-phase circuits, the phase displacement between the series and the shunt field flux is obtained by the use of two shunt coils connected in series but wound in opposite directions on the limbs of an electro-magnet provided with four pole-pieces. The series winding is disposed, partly on two of these pole-pieces and partly on a separate electromagnet facing them. The resulting fluxes are practically 90 time degrees apart, and react upon an ordinary metal disc and cause it to rotate.—Lond *Elec. Eng'ing,* Oct. 3.

Resistance Coils.—C. V. Drysdale.—The continuation of his paper on resistance coils and comparisons. The author gives some forms of standards of low resistances less than 0.1 ohm and then gives a full account of numerous resistance alloys and their electrical and mechanical properties, like nickeline, constantan, maganine, etc. The article is to be continued.—Lond. *Electrician,* Oct. 4.

Testing Insulation Resistance.—J. Sahulka.—An illustrated translation in abstract of his German paper on the measurement of insulation resistance and capacity of individual conductors of an alternating-current net-work without interruption of service.—Lond. *Electrician,* Oct. 4.

Telegraphy, Telephony and Signals.

Thermophone and Continuous Electric Oscillations.—F. Weinberg.—The author first refers to the old thermophone of Preece, and then shows how hot rheostats, electric furnaces, etc., may be used as thermophones. For instance, a rheostat

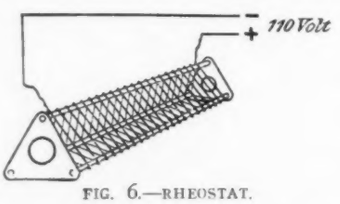


FIG. 6.—RHEOSTAT.

(Fig. 6) which is sufficiently long and so constructed as to enable good air circulation, when connected to a lighting circuit at 110 volts, reproduces clearly the sound of the running machines (commutator interruptions) in the central station. The author found that this phenomenon took place when the wire had been heated to 37 degrees C., and the temperature of the air was 19 degrees C. When the air was cooled and the speed

of ventilation was increased the sound became stronger. An arc lamp inserted in the same circuit as shown in Fig. 7 reproduces sounds and speech spoken into the microphone *Mi*, the microphone currents being transmitted to the arc circuit by means of the transformer *T*. If several rheostats are connected in series the intensity of the sound is considerably increased. The surprisingly strong effect obtained with this arrangement is thought by the author to be due to the following circumstances. The current oscillations of the microphone are transmitted by means of the transformer to the arc, the resistance of which is varied according to the oscillations, where-

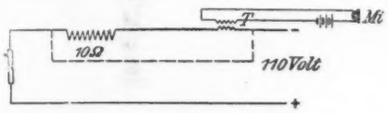


FIG. 7.—THERMOPHONE CIRCUITS.

by the main current of the lighting circuit and the rheostat in the same are acted upon. When the lighting circuit was suddenly disconnected and at the same time the hot rheostat and transformer were short circuited, as indicated by the dotted lines in the illustration, the rheostat reproduced the words of the microphone with greatly reduced intensity and only until it had cooled down to about 35 degrees C. The author thinks that any little wire piece of a telephone circuit when artificially heated would reproduce the telephone message to a sufficiently sensitive ear. Fig. 8 shows an experiment in which a rheostat was brought to incandescence by means of a 110-volt storage

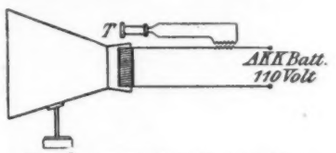


FIG. 8.—THERMOPHONE CIRCUITS.

battery. The telephone *T* which was in inductive connection with the storage-battery circuit by means of a transformer, reproduced the sounds spoken into the megaphone. Another experiment is shown in Fig. 9 in which the Duddell arrangement using a capacity and a self-induction in shunt with the heated element was used. As heated element, rods of thorium, cerium (well known from the Nernst lamp) are suitable. *A K K* represents a storage battery, *M* the microphone. If the thorium rod is used in a hydrogen atmosphere hydrogen gas being passed through the box in the direction of the arrows shown in the figure, the arrangement represents a stable gen-

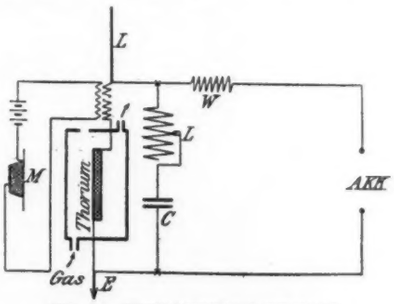


FIG. 9.—THERMOPHONE CIRCUITS.

erator of undamped electric oscillations and may be used as a substitute for the unstable arc in the Poulson method.—*Elek. Zeit.*, Sept. 26.

Change-over of Telephone System.—W. V. LONNON.—The change-over of the Gerrard telephone exchange in London to central-battery working was recently carried out. Fifteen minutes had been allowed for the transfer, although, of course, many months had been occupied in the requisite preparation and organization, and the actual change-over was accomplished well within that period. The new plant has been erected in a building adjoining the old exchange, and the lines had been diverted and tied to the new main frame, so that the old and new equipments were connected in parallel. The necessary alterations had also been made in the subscribers' instruments, and the junction circuits incoming from Gerrard in other exchanges. Previous to the transfer, the cut-off relays on the subscribers' circuits in the new exchange were disconnected by the insertion of wooden pegs, so that the heat coils could be fitted on the new main frame. The heat coils on the old test-board were looped together in small groups by means of tape. At the given time, these heat coils were pulled out, and then men waiting at the relay racks were given the signal to pull out the pegs from the cut-off relays.—Lond. *Elec. Eng'ing*, Oct. 3.

Wireless Telephony.—R. A. FESSENDEN.—An illustrated paper in which the author gives an account of the wireless telephone system of the National Electric Signalling Company in operation between Brant Rock and New York, a distance of nearly 200 miles. The apparatus, which includes a high-frequency alternator, worked at 81,700 periods, and telephonic relays, is described, and the commercial possibilities of wireless telephony are discussed.—Lond. *Electrician*, Oct. 4.

Miscellaneous.

Lubricating.—K. LENZ.—A long discussion on the best methods of lubricating high-speed machinery.—*Zeit. d. Ver. Deutscher Ing.*, June 1, abstracted in *Elek. u. Masch.*, Sept. 15.

London Exhibition.—Illustrated descriptions of the various exhibits at the engineering exhibition at the Olympia in London. Machine tools seem to represent the predominant feature as illustrated in London *Electrical Review*, Oct. 4, while several apparatus for the scientific control of combustion in raising steam and its subsequent utilization in power plants are described in Lond. *Electrician*, Oct. 4.

BOOK REVIEWS.

MOTEURS A COLLECTEUR A COURANTS ALTERNATIFS. By Dr. F. Niethammer. Paris: *L'Eclairage Electrique*. 131 pages: 138 illustrations. Price, 5 francs.

The book presents the electrotechnical theory of alternating current commutator motors from the engineer's standpoint. It also briefly discusses the history of the development of this type of motor. The work is divided into three chapters. Chapter I contains a general discussion of the subject, including its outline history. Chapter II deals with the theory of such motors with relation to vector diagrams, and covers their torque, power-factor, speed-regulation, braking and commutation. Chapter III relates to structural details, and refers to various installations and applications of these motors. In view of the importance of the modern alternating-current series motor, the book deals with a prominent technical subject of the present day. It is clearly written. The work will be appreciated by students and designers of alternating-current motors.

A new electrical engineers' pocket-book with the title of "Standard Handbook for Electrical Engineers," is announced by the McGraw Publishing Company of New York, to appear about Nov. 15. A partial list of the authors and subjects is as follows: A. S. McAllister, Ph. D., "Transformers and Motors"; H. M. Hobart, "Generators"; George Shaad, "Central Stations"; Louis Bell, Ph. D., "Illumination"; A. H. Armstrong, "Electric Traction"; E. F. Roeber, Ph. D., "Electrochemistry"; Kempster B. Miller, "Telephony." The book is divided into 20 sections as follows: Units, circuits, instruments and measurements, materials, magnets, transformers, generators, motors, batteries, central stations, transmission and distribution, illumination, electric traction, electrochemistry, telephony, telegraphy, miscellaneous applications of electricity, wiring, standardization rules, tables and statistics. The book will be printed on "bible" paper, bound in flexible morocco, and will contain over 1300 pages and more than 1500 illustrations, all of which were especially prepared for the book. The price will be $4 net.

Time-Limit Relays.

By M. C. Rypinski.

Continuity of service is an essential consideration in all installations, and interruption of the service cannot be tolerated unless the protection of the apparatus demands it. There are, however, certain abnormal conditions of current which may exist for a short time on a circuit without causing serious damage, such as swinging "grounds," intermittent short-circuits, synchronizing cross-currents, etc. The simple instantaneous relay would in such cases act instantly and interrupt the service unnecessarily. There has, therefore arisen the necessity for a relay having a retarded or time-element action. For certain service it is sufficient that this retarded action have a definite predetermined value independent of the load condition. Such a relay is termed a "definite time" limit relay. For other service, it is necessary that this time element vary inversely with the load; that is, with greater load, the time element should be less and vice versa. Such a relay is termed an "inverse time" limit relay.

Instantaneous relays are used where it is desired to give protection only at the limiting current carrying ability of the apparatus.

Definite-time-limit relays are used where it is necessary to maintain service on a given circuit at all hazards for a predetermined time. This relay allows temporary "grounds" and short-circuits to "clear" by burning themselves out, and it prevents synchronizing cross-currents from opening the breakers. Most desirable of all, however, it enables instantaneous and inverse-time-limit relays on contiguous circuits of less importance to operate and "cut off" under disturbances without opening the important circuit, even though the latter is temporarily heavily overloaded during the disturbance.

Inverse-time-limit relays possess two valuable characteristics, as follows: (1) Their delay in operation is inversely proportional to the strain on the system; the greater the strain the quicker the relay will operate. (2) By virtue of (1) they act "selectively" those nearer a point of disturbance in a system, and which, therefore, receive the greatest load, operating first—disconnecting the affected portion and "clearing" the system while confining the disturbance to a minimum area. As an example—consider a system of three feeders, 1, 2 and 3 of Fig. 1—connecting a set of power station bus-bars *A* with a set of sub-station bus-bars *B* and protected with automatic circuit-breakers controlled by overload inverse-time-limit relays at *D*, *E*, *F*, and reverse power inverse-time-limit relays at *P*, *Q* and *R*. Each overload relay will be adjusted for operation at the same current as the others; likewise each reverse power relay will be adjusted for operation at the same current as the others.

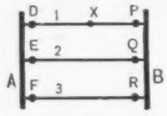


FIG. 1.—DIAGRAM SHOWING FAULT ON FEEDER.

Assume now that a short-circuit develops in 1 at point *X*. All three feeders will at once supply energy to the short circuit from *A*. If *B* is a synchronous converter sub-station, the converters by virtue of their enormous stored rotative energy, may tend to supply energy also, but as this has no particular bearing on the facts to be brought out, it will not be further considered. *D* being nearest the fault *X*, and, therefore, in the circuit of the least line drop, will receive more current than *E* and *F*. By virtue of the inverse time law it, therefore, operates first or "selectively" disconnecting the feeder 1 from *A* before *E* and *F* have time to act. Simultaneously *P* has been receiving energy in the reverse direction through bus-bars *B* from feeders 2 and 3, and has disconnected feeder 1 from *B*. *Q* and *R* will not operate, as they receive energy only in the normal direction and *E* and *F* will not operate as the fault has been isolated and they have been relieved of their overload before they have had time to act. In actual practice on alternating circuits, relays *P*, *Q* and *R* will operate on both overload and reversal of power, and they are so designed that the operation on reversal of power is at a much lower value of current than on overload (about one-third to one-eighth in representative types). If overload and reverse power relays were used at *P*, *Q* and *R*, the relay at *P* would operate sooner than *Q* and *R*, for the reverse fault current through *P* is the sum of the normal fault currents through *Q* and *R*.

Where only two feeders exist, such as 1 and 2, both *P* and *Q* would receive the same amount of fault current and the selective action is not so great, but is still amply sufficient to allow *P* to operate before *Q*, on account of the difference between their reverse and overload tripping values.

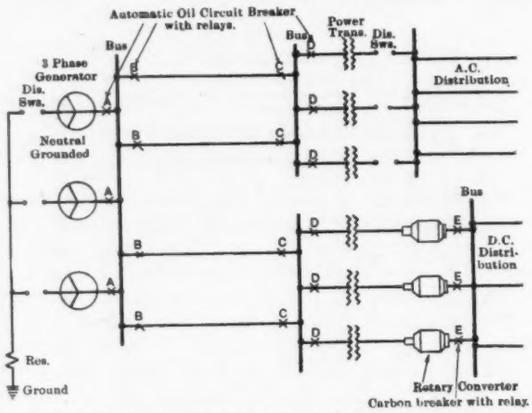


FIG. 2.—RELAYS IN A FOUR-WIRE THREE-PHASE SYSTEM.

Similarly to the definite-time-limit relay, the inverse-time-limit relay will allow temporary "grounds" or short-circuits to "clear" themselves, and it will prevent synchronizing cross-currents from opening the breakers. The action is somewhat more limited in the latter on account of the inverse feature, but it is amply sufficient for all ordinary conditions.

Time-limit relays in their simplest form consist of three elements: (1) the actuating mechanism energized by the line source to be protected; (2) a set of contacts operated thereby; (3) the time-limit feature.

The actuating mechanism may assume any form which will give operation under the desired conditions. It usually involves a motive device consisting of a solenoid and a core, a rotating motor, or some form of instrument movement.

Tripping mechanism usually consists of a set of moving platinum, silver or carbon-tipped contacts engaging a corresponding set of stationary contacts. Some relays have single contacts for closing a single tripping circuit; others are provided with multiple contacts for closing two or more tripping circuits, as in the operation of double-throw systems, where a relay in the main circuit has to operate circuit breakers in each of the duplicate feeder bus-bars.

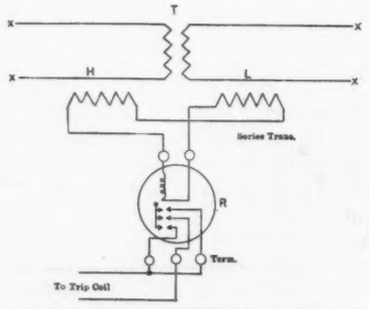


FIG. 3.—RELAY FOR TRANSFORMER PROTECTION.

The usual arrangement of relay contacts provides for their closure upon the operation of the relay, in which case the relay is spoken of as being provided with "shunt-trip contacts." The contacts are connected in series with the tripping circuit of the breaker and an independent source of electrical energy and

upon closing energize the tripping circuit and open the breaker. The tripping coils are wound for shunt operation from the independent source, which is usually a direct-current exciter circuit or a storage battery, and the circuit-breaker is spoken of as being equipped with shunt-trip coils. The operation of shunt tripping coils from the circuit being protected is inadvisible, owing to the liability of the trip coil failing to operate on the low voltage existing under short-circuit and overload conditions.

On an alternating-current system, where an independent source of energy is not available, the circuit-breakers are provided with series tripping coils wound for operation from series transformers in the main circuit. Overload relays are also provided with series-trip contacts, which differ from the shunt-trip contacts in being normally closed instead of open and opening upon operation of the relay. They are connected in shunt with the series trip coils, thereby short-circuiting them. Upon operation of the relay they open, sending the transformer secondary current through the trip coils and trip the breaker.

FIG. 4.—POLYPHASE OVERLOAD RELAY WITH INVERSE TIME ELEMENT.

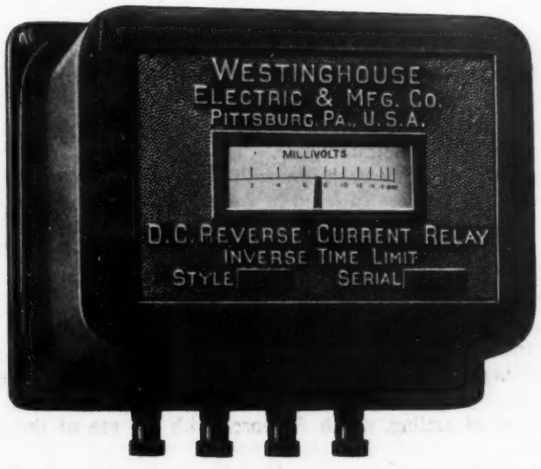


FIG. 5.—DIRECT-CURRENT REVERSE-POWER RELAY WITH INVERSE TIME ELEMENT.

As there is always sufficient current under overload and short-circuit conditions to operate the trip coils, this arrangement is as satisfactory as shunt tripping.

The application of relays to any certain system depends almost entirely upon the local conditions of operation, varying somewhat with each installation. Representative practice recommends the placing on generator circuits of either a reverse-power relay with a time-limit feature or else the entire elimination of automatic protection.

Feeder Circuit Protection: For feeders at the power station end overload-inverse-time-limit relays are desirable. For feeders at the sub-station end overload and reverse-power inverse-time-limit relays are desirable.

With synchronous converters, an overload inverse-time-limit relay in the high-tension side of the main transformers will give protection for the alternating-current side. For the direct-current side a reverse-power inverse-time-limit relay operating the direct-current breakers will be required.

An example of the relaying required in a typical four-wire, three-phase system is illustrated in Fig. 2. Three generators, operating with their neutral points grounded through a resistance, feed a common bus system, four sets of feeders, main transformers, converters, etc., for alternating-current and direct-current distribution of energy. Automatic circuit breakers are inserted operated by relays as follows: at *A*, alternating-current overload and reverse-power inverse-time-limit relays; at *B*, alternating-current overload inverse time-limit relays: at *C*, alternating-current overload and reverse-power inverse-time-limit relays; at *D*, alternating-current overload inverse-time-limit relays; at *E*, direct-current reverse-power inverse-time-element relays.

The relays at *A* are intended for reverse protection only and so have their overload adjustment set at the maximum value.

In sub-stations, where many transformers are operated in parallel, a damaged transformer may be disconnected by means of the arrangement illustrated in Fig. 3. Here *T* represents any one of a bank of transformers connected in parallel, in the high and low-tension sides of which are connected relay transformers *H* and *L*, arranged so that their secondaries are in series and e. m. f.'s oppose each other. These relay transformers are so selected as to tend to give the same secondary current under all normal conditions, under which therefore the overload relay *R* will not be affected. In the event, however, of a short-circuit developing within the transformer the two sides will be unbalanced and the resultant current will be sufficient to operate the relay and disconnect both the high and low-tension sides of the transformer. Figs. 4 and 5 represent types of inverse-time-limit relays.

Meeting of General Electric Managers.

The managers of the General Electric Company have just held their annual meeting at the main office of the company in Schenectady. Owing to the national interest taken in the business affairs of the industrial world to-day the principal topic during the afternoon was a discussion of the general situation in the electrical field. Due to the fact that Vice-President J. R. Lovejoy has not entirely recovered from his recent illness, Vice-President B. E. Sunny, of Chicago, presided.

The satisfactory condition of the company's business was indicated by a statement that orders received during the current year to date exceeded those of the corresponding period of last year by fully 15 per cent. The volume of orders and the prospective demand for supplies and for the various lines of smaller electrical devices which the company manufactures, are very satisfactory.

Dr. Thomas Addison, manager of the Pacific Coast territory, reported a recent order for a Curtis steam turbine generator of unusual size. This machine, which will be one of the largest energy producers ever built for electrical purposes, will have a normal capacity of 20,000 horse-power.

Generally encouraging sentiment regarding the business outlook prevailed among the company's managers. The company's foreign business continues to show gratifying increases.

Among those in attendance were the following: C. A. Coffin, president; E. W. Rice, Jr., vice-president; Hinsdill Parsons, vice-president; B. E. Sunny, vice-president, Chicago; Anson W. Burchard, assistant to president; M. F. Westover, secretary; H. W. Darling, treasurer; Edward Clark, general auditor; J. R. McKee, manager power and mining department; W. J.

Clark, manager foreign department; C. H. Haskins, manager lighting department; J. G. Barry, manager railway department; D. R. Bullen, manager supply department; G. E. Emmons, manager, Schenectady works; W. C. Fish, manager Lynn works; George F. Morrison, manager Harrison works; Thomas Addison, Pacific Coast manager; E. D. Mullen, manager Philadelphia office; C. B. Davis, manager Boston office; Gen. Irving Hale, manager Denver office; T. Beran, manager New York office; A. F. Giles, manager Atlanta office; J. B. Pevear, manager Cincinnati office; E. E. Gilbert, turbine sales manager; P. D. Wagoner, transformer sales manager; A. D. Page, manager incandescent lamp sales; W. L. R. Emmett, engineer lighting department; D. B. Rushmore, engineer power and mining department; M. P. Rice, publication bureau; F. H. Gale, in charge of advertising.

Annual Show of Automobile Club of America.

The eighth annual exhibition of the Automobile Club of America was held in the Grand Central Palace, New York City, Oct. 24-31. Affiliated with the Automobile Club of America was the American Motor Car Manufacturers' Association, whose members contributed a majority of the machines on exhibition. One of the interesting sidelights of the show was the presence of the aeronauts and of the balloons which competed in the recent international balloon race at St. Louis. The Motor & Accessory Manufacturers' exhibits were more numerous than ever.

Of the numerous pleasure and other vehicle manufacturers represented but two were makers of electric vehicles. The Anderson Carriage Company of Detroit, Mich., exhibited two pleasure vehicles and the Lansden Company of Newark, N. J., showed one pleasure and a number of commercial vehicles. Offsetting these were about 65 manufacturers of gasoline vehicles, eight of whom showed commercial trucks also. Taken as a whole the show offered nothing radical in automobiles, the tendency being, if anything, towards a standard practice so that new yearly models are becoming things of the past.

Six-cylinder cars have greatly increased in number; but one, two and four-cylinder engines still hold their own. Jump spark ignition leads and is double in a great many vehicles; while make and break are occasionally seen. The use of the magneto both for jump and make and break spark has largely increased; more than half of the cars shown being thus equipped. Many of the other cars were equipped with two sets of batteries. Storage cells apparently predominated although the present dry cell has been so thoroughly adapted to automobile use by its makers that excellent results are obtained from it.

Below are given brief descriptions of some of the exhibits made by the Motor & Accessory Manufacturers:

The Oliver Manufacturing Company displayed its line of jacks for automobile use.

The Electric Storage Battery Company showed a line of its well-known chloride accumulators for automobile work.

The Ampere Manufacturing Company displayed a line of "Best" dry cells for automobile, gas-engine and telephone work.

The Joseph Dixon Crucible Company had on exhibition various forms of its graphite products, as applied to automobile lubrication.

The Western Electric Company showed battery-charging dynamos and motor-generators made by the company for the automobile trade.

The Whitney Manufacturing Company displayed various sizes of chains and a patent system of keying largely used in the construction of automobiles.

The B. F. Goodrich Company exhibited its regular clincher type of smooth, Bailey and flat threads. An opportunity was also given of testing the company's quick-detachable tires and rims.

The William Cramp & Sons Ship & Engine Building Company displayed manganese bronze castings of every conceivable shape for automobile use. This great shipbuilding house has specialized in work of this kind.

The Eastern Carbon Works showed their gas engine dry cells, particularly designed for the rigorous service required in automobile work. Battery connectors guaranteed not to shake loose under the most severe conditions of vibration and jolting were also a feature.

American Electric Novelty & Manufacturing Company, the originators of "Ever Ready" specialties, had on exhibition a line of dry cells especially made for automobile ignition service. These batteries are made in many sizes and are put up for automobile and motor-boat use.

Morgan & Wright had as the most prominent feature of their exhibit the improved Midgley universal rim for use with their clincher or Dunlop tires. This rim will accommodate every type of mechanically fastened tire but one. A full line of Morgan & Wright's tires was also on view.

The National Carbon Company displayed its well-known line of Columbia dry cells, prominent among which was the "Red-Top Columbia Igniter" cell manufactured especially for automobile use. The company also distributed a pamphlet entitled "Helps and Hints of the Motor Car."

The Heinz Electric Company which has long been identified with the manufacture of induction coils for use with X-ray apparatus displayed its coils for ignition purposes. These are made in interchangeable unit types, from 2 to 6 cylinder styles, and are mounted in waterproof cases with switch.

The Whitlock Coil Pipe Company's automobile department exhibited a number of different types of coolers, hoods, and motor manifold connections of special construction, and in a variety of designs. These consist of inlet manifolds of copper and brass, steel exhaust manifolds, and other specimens of bent-pipe work.

The Hess-Bright Manufacturing Company had on exhibition a full line of its annular ball-bearings. A feature of the company's exhibit consisted of two railway axles taken from a standard passenger coach that had traveled 65,000 miles. No appreciable wear or other depreciation was visible, demonstrating in a striking manner the capabilities of the company's ball bearings under severe service conditions.

The Veeder Manufacturing Company had on exhibition its tachodometer. The indicator shows the speed of the car from 0 to 64 miles; or when required to have close readings at slower speeds the scale reads from 0 to 32 miles an hour. It is only necessary to move a small lever to the right and the instrument is adjusted for high-speed work. No springs or delicate moving parts are incorporated in the system.

The Connecticut Telephone & Electric Company displayed spark coils in both automobile and marine types; lever switches, plug switches, indicators, etc. The company's standard unit type dash coils were shown with all numbers of units from 2 to 6. These were enclosed in a mahogany case with protected terminals. The switch is made waterproof so that the efficiency of the ignition apparatus will not be lessened through leakage.

The National Battery Company featured the complete components of its cell, mounted on an ornamental panel, so that the features of construction were easily studied. Sparker, vehicle and truck batteries were shown, a new method of assembling and sealing the sparker batteries having been made in the 1908 model of these accumulators. The company's method of sealing, which dispenses with the use of the usual sealing compounds, was also shown.

C. F. Splitdorf's synchronized distributing coil was one of the chief objects of attraction amongst the numerous ignition specialties exhibited. By means of this coil the firing of a multi-cylinder engine is accomplished in each cylinder at the proper time without any of the detrimental effects usually experienced with a single coil, as a different unit supplies the secondary current for each cylinder. These new coils are made up in any number of units and are suitably mounted in a standard type of mahogany case.

The Dayton Electrical Manufacturing Company's exhibit consisted of a dynamo and storage-battery charging system in

complete working order. The outfit comprises the well-known Apple dynamo, a switchboard and a portable lead bottle-type of accumulator. The dynamo is friction-driven from the flywheel of the engine and charges the battery. The timers, coils and plugs of the system were all in plain sight of the spectator at the show, so that the working of the system could be seen at a glance. The nature of the spark produced was also shown.

THE ATWATER-KENT MANUFACTURING WORKS made one of the most interesting exhibits shown in the line of ignition apparatus. A spark-generating outfit with six small dry cells was sealed in a glass case and driven from outside by means of a small motor, a speedometer and odometer being attached to indicate the equivalent rate of speed traveled and the distance covered during the time of the test. The exhibit was intended to demonstrate the reliability and low consumption of the Atwater-Kent apparatus. The regular line of spark generators, meters and switches was also displayed.

Illumination of Baltimore in Home Week.

BY LAURANCE JONES.

Baltimore signalized Maryland's Home Coming Week, Oct. 13 to 20, by an illumination of the principal thoroughfares and public buildings upon a scale far surpassing any previous displays of this character. The installation was approximately the equivalent of 45,000 4-cp lamps. Baltimore street for a distance of one mile, Eutaw Street for half that distance, Lexington and Charles Streets for a number of blocks were spanned at frequent intervals by streamers of incandescent lamps. The City Hall, Post Office and Court House, occupying three adjacent city blocks, were elaborately outlined and decorated. Numerous minor public buildings in various parts of the city were similarly treated. Arches, brightly illuminated, welcomed the home comer at the principal railway stations. An electric fountain was erected at the intersection of Baltimore Street and the principal wholesale thoroughfare. A Court of Honor, composed of staff columns spirally wreathed in incandescent lamps and streamers of lamps, all surmounted by a crown of orange-colored lamps, marked the geographical center of the city.

The street loops, supported by spans of No. 12 iron wire attached to buildings upon opposite sides of the street, and suspended therefrom at two points, one over each curbline, consisted of No. 10 weatherproof wire; receptacles were of the "pigtail" type, spaced 15 ins. apart. Feeders, consisting of three strands of No. 8 weatherproof wire, equally balanced on opposite sides of an Edison three-wire, 120-240-volt system, were supported by cleats fastened to a wooden backing banded to the trolley poles. Connections between loops and feeders were made through fuse blocks adequately protected from the weather. Energy was supplied through 11 overhead emergency connections, each controlled by a fused knife switch. Eighty-five loops were erected, averaging 60 4-cp lamps to the loop, aggregating about 5000 4-cp lamps.

The City Hall dome, rising to a height of 200 ft., was outlined in every detail with 8-cp lamps spaced 15 ins. apart. The cornices of this building were also outlined, lamps of 4 candlepower being placed at intervals of 15 ins. The Elblight system was used throughout. The load was equally balanced on opposite sides of an Edison three-wire, 120-240-volt system, and was controlled by a fused knife switch. Approximately 5000 8-cp and 3500 4-cp lamps were used.

The towers, windows and cornices of the Post Office were outlined with 4-cp lamps spaced 15 ins. apart, in Fielding cleat receptacles. Circuits of No. 12 wire connected through fuse blocks to sub-feeders of No. 10 weatherproof wire; these were in turn connected through fuse blocks to feeders of 300,000 cir. mil cable controlled by fused knife switch. The load was balanced on an Edison three-wire, 120-240-volt system. About 6000 4-cp lamps were used.

The cornices, windows and doorways of the Court House were outlined in 4-cp lamps spaced 15 ins. apart; surmounting the cornices were 16 flower pots consisting of vari-colored lamps. The Elblight system was used throughout. The load was balanced on an Edison three-wire, 120-240-volt system. Approximately 15,000 4-cp lamps were installed.

The minor public buildings were outlined and festooned in 4-cp lamps, the Elblight system and the Fielding cleat receptacle being used. The respective installations were as follows: Entrance to Fifth Regiment Armory, 1200 4-cp lamps; "Number Six" Engine House, 800 4-cp lamps; Shot Tower, 800 4-cp lamps. The Wells and McComas Monument was lighted by 200 4-cp lamps.

Each street arch was equipped for 600 4-cp lamps placed in Fielding cleat receptacles. The electric fountain was lighted by seven 15-ampere and two 5-ampere arc lamps, together with 105 8-cp lamps. The color changes were accomplished by means of revolving screens rotated by a small motor. The Court of Honor contained about 1500 4-cp lamps.

The wiring and construction was performed under specifications which required compliance with the very rigid inspection laws in force in this city, and was satisfactory in every respect, both from the mechanical and electrical standpoints. In the decoration of the public buildings, contractors were forbidden to use nails or screws, and were compelled to rely upon bands and clamps to support all the equipment.

From the detailed description of the equipment, it will be seen that a total of approximately the equivalent of 45,000 4-cp lamps was used. This equipment was lighted at 7 o'clock each night and extinguished at midnight. In all, 42 hours' use was made of the entire installation, requiring about 38,000 kw-hours of electrical energy.

All the energy was contributed generously free of cost by the Consolidated Gas, Electric Light & Power Company, of Baltimore.

In commenting upon the success of the Home Coming Week celebration, the mayor of Baltimore stated that "Most of that success was due to the glorious illumination which marked our nights."

Synchronism and Constant-Speed Apparatus.

The development of automatic and machine telegraphy has necessitated the production of synchronously operating rotary mechanisms; that is, a motor at one terminal of a telegraphic line must be so controlled that it will run at precisely the same speed as a generator at the other end of the line. This synchronism can only be considered perfect when the two machines run as if they were both attached to opposite ends of a rigid shaft extending from one station to the other. To accomplish such synchronism, many complicated devices have been resorted to. The problem involved in the case of synchronism for telegraphic purposes is to cause a rotary device to run with a speed of rotation strictly proportional to the speed of vibration of some vibrating reed or relay tongue. If the vibrating member gradually varies in its speed of vibration, the rotating machine will vary in its speed of rotation. If the vibrating

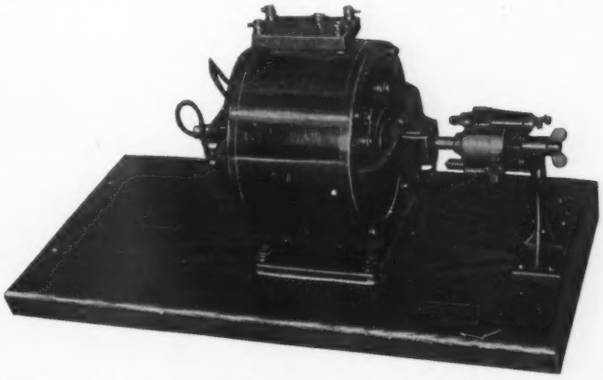


FIG. 1.—SYNCHRONOUS CONVERTER WITH ATTACHED COMMUTATOR.

member has a constant periodicity, the rotation of the rotating machine will also be constant. If the rotating machine is an alternator and the controlling vibrating member is a tuning fork, having constant frequency of vibration, the alternating current furnished by the generator will have constant frequency, provided the generator runs in perfect synchronism with the vibrating tuning fork. Such an alternating current of known and constant frequency, from which, by well known methods, the harmonics may be removed, is extremely useful in measuring many electrical quantities. There are many methods for determining inductances and capacities, in which the frequency enters into the formulæ expressing the values to be measured. If the frequency, therefore, is accurately known, the quantities can be measured in very simple ways.

The Leeds & Northrup Company has developed an extremely simple, novel method of running an alternator in perfect synchronism with any rapidly-vibrating contact maker. It is now placing upon the market a 200-watt synchronous converter, with a commutator attached for purposes to be described, and a large electrically driven tuning fork, which controls the speed of the synchronous converter in a very perfect manner. A transformer is also furnished as a part of the outfit. Fig. 1 shows the rotary converter with its attached commutator; Fig. 2, the electrically-driven tuning fork. The diagram of connections,

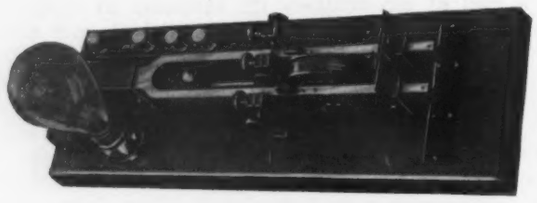


FIG. 2.—ELECTRICALLY-DRIVEN TUNING FORK.

Fig. 3, together with a few words of explanation, will make it plain how the tuning fork is able to control the speed of the rotary converter. The direct-current side of the converter is joined through a resistor of variable resistance to a 110-volt circuit. Leads from the alternating-current terminals go direct to the load circuit of the machine, and other leads go from the same terminals to the primary of a small transformer. The secondary of this transformer is joined by a pair of leads to the speed-controlling tuning-fork mechanism. A study of the diagram will show that as the tuning fork vibrates, two contacts, *a* and *b*, are opened and closed, throwing the load taken by a 32-cp lamp off and on the secondary of the transformer. Two small condensers, shown in the diagram, serve for eliminating the sparking which otherwise would occur at the contacts, *a* and *b*, as well as at the contact *d*. This last contact is

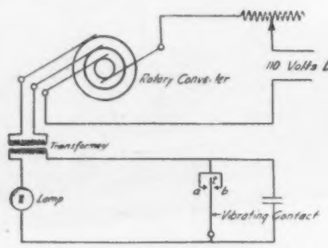


FIG. 3.—SIMPLIFIED DIAGRAM OF CONNECTIONS.

used to maintain the vibration of the fork, the fork itself being operated by an electromagnet on the direct-current circuit. A telephone receiver, shunted over a small resistance, enables one readily to ascertain when the rotary converter has come into synchronism with the tuning fork.

Fig. 4 is a diagram showing all of the connections, including the operating circuit for the fork. There are supplied with the tuning fork adjustable weights, which being set at different positions on its prongs, enable the speed of the tuning fork to be greatly varied in coarse steps. A small U-shaped spring is placed betwen the prongs of the fork, the ends of this spring pressing against the prongs. This spring can be moved by a screw parallel to the prongs while the tuning fork is vibrating, and so vary the speed of vibration by infinitesimal steps over a small range. Thus, with the weights, and the spring, the fork can be driven at any desired speed, and the rotary converter will produce any desired frequency. The speed of rotation of the generator will, of course, be as constant as the vibration of the tuning fork. Experiments have shown that a good fork will give the same number of vibrations in one hour as in the succeeding hour, within one-fiftieth of 1 per cent.

The commutator, which is mounted upon the shaft of the rotary converter, has no connection whatever with the running of the apparatus in synchronism, but serves the purpose of converting the alternating current into direct current. By passing alternating current through four arms of a Wheatstone bridge arrangement and rectifying it with the aid of this commutator, an ordinary D'Arsonval galvanometer may be used to indicate when the bridge is balanced for alternating currents; thus the arrangement becomes suitable for the accurate comparison of inductances and capacities.

The commutator on this machine may be somewhat modified so as to make and break contact in circuit with a secondary of a transformer, the primary of which is connected to the terminals of an alternator of large rating. It thus becomes prac-

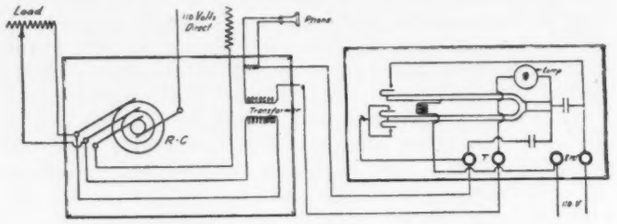


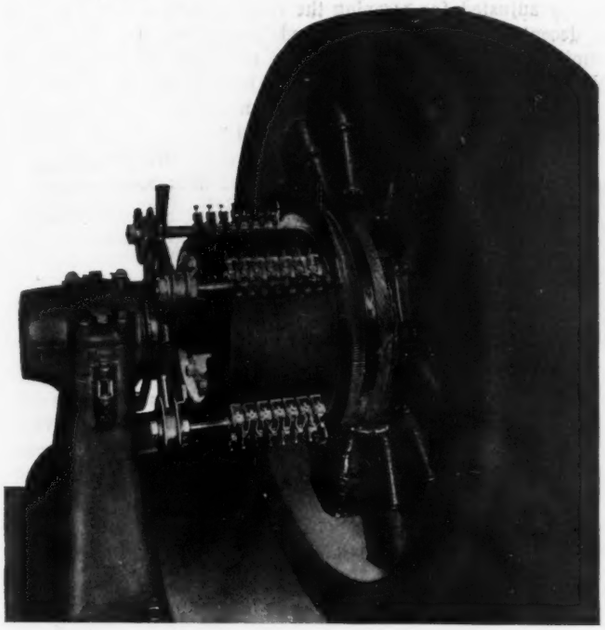
FIG. 4.—COMPLETE DIAGRAM OF CONNECTIONS.

ticable to control with the tuning fork, through the intermediation of a small machine, the speed of a very large alternator. The difficulties encountered with many previous methods of obtaining synchronism have come largely from a tendency which large machines have to "hunt." By the methods of synchronism here described, such tendency is entirely damped out electrically, and no mechanical devices are required to damp out the "hunting," such as are used on the synchronized machines which are used in connection with "machine telegraphy." The constant speed of rotation obtained enables chronographs to be driven with very great precision, and other uses of constant rotation are readily suggested to those working on physical problems.

Variable Transformation Ratio Synchronous Converter.

The accompanying illustration shows a special form of synchronous converter designed for use in connection with storage batteries. The machine is provided with "split-poles," the field winding being so arranged that the flux distribution over the pole face may be changed during operation. Thus, since the direct voltage bears to the alternating voltage the ratio of the maximum of the alternating e. m. f. wave to its effecive value as measured between phase lines, the ratio of the delivered direct e. m. f. to the supplied alternating e. m. f. changes with the change in flux distribution. In consequence of the "split-pole" construction and special field windings there is a large range of voltage at the commutator with a constant value of e. m. f. at the collector rings, and hence series reactance need not be used in the supply leads, and a booster is not required in the leads between the converter and the storage battery. The variation of the voltage at the brushes to which the battery is directly connected, and which is effected by the special field winding controlled by a carbon-regulator, compels the battery to charge and discharge in response to fluctuations of load on the alternating-current

circuits, energy being transmitted in either direction between the battery and the alternating-current circuits. Thus the load on the supply generators may be kept approximately constant



FIGS. 2 AND 3.—DIAGRAMS OF BOTTLE-CONVEYING INSTALLATION.

at the average demand although the instantaneous demand may fluctuate throughout a very wide range.

The above described regulating equipments are built by the Electric Storage Battery Company, Allegheny Avenue and Nineteenth Street, Philadelphia, Pa.

Motor Bottle-Conveying System.

A new bottle-conveying system having a capacity exceeding 20,000,000 bottles a year, was recently installed in the brewery of S. Liebmann's Sons, Brooklyn, New York, by the Philadelphia works of the Link-Belt Company. The general view of this installation, Fig. 1, which was devised from plans by Mr. Adolph Liebmann, shows the bottles en route from the filling and capping machines to the labeling machines. The equipment comprises two horizontal chain conveyors made up of single-

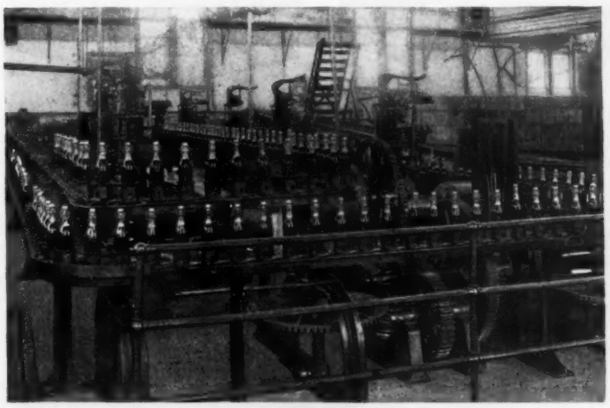
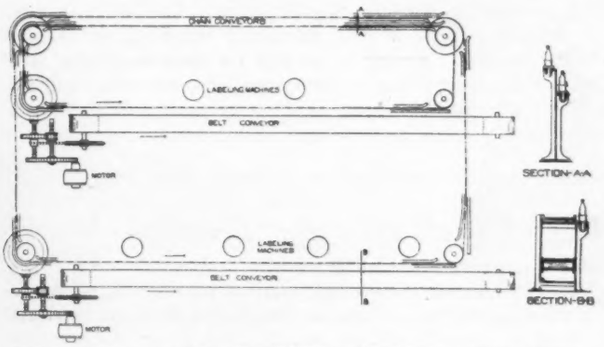


FIG. 1.—GENERAL VIEW OF BOTTLE-CONVEYING INSTALLATION.

strand Ewart link-belt, and supplemented by two belt conveyors. The chain conveyors run on angle-iron tracks supported at intervals by the cast-iron frames shown in detail cross-section view, Fig. 3. These frames are made in two styles, one a combination chain and belt conveyor support, and the other to accommodate the side-by-side runs of both chain conveyors. The bottle holders, of cast-iron and rigidly attached to the chain, are designed to permit quick, easy loading and, by a sufficiently snug fit, to assure safety in transportation.

The operation of the system is set forth in the diagram



FIGS. 2 AND 3.—DIAGRAM OF BOTTLE-CONVEYING INSTALLATION.

illustrated, Fig. 2. The chain conveyors traverse rectangular paths of different size, that followed by the larger or "outer" conveyor approximating 45 ft. in length by 11 ft. in width, the dimensions for the smaller ("inner") conveyor being about 42 ft. x 6 ft. The belt conveyors, before mentioned, parallel the labeling-run of each chain conveyor.

As the bottles are filled and capped, they are transferred manually to the chain conveyors for delivery to the labeling machines, four of which are served by the "outer" conveyor and two by the "inner" one. As they pass in front of the labeling operators attending the outer conveyor, the first man picks up every fourth bottle, the operators at the succeeding machines each removing one of the remaining three; bottles are taken alternately from the inner conveyor. The labeled bottles are placed upon the contiguous belt conveyor and delivered to the casing department. The conveyors are driven by General Electric motors.

Turbines for the Utilization of Exhaust Steam.

Willans & Robinson, of Rugby, England, the builders of high-speed turbines and steam engines, have been recently engaged on the construction of turbines for the utilization of exhaust steam, and have at present under construction at their works two machines of the normal output of 1350 kilowatts with an overload capacity of 2000 kilowatts. These are the largest exhaust turbines constructed in Europe. These machines are for the Samuelson shops at Middlesborough, and have been arranged to take steam from a number of non-condensing blowing engines, used for supplying air to blast furnaces.

The turbines are coupled to three-phase generators working at 40 cycles, 3000 volts, and running at a speed of 2400 revolutions per minute. This is a very high speed for the output developed. The machines will work in parallel with a number of other turbines in the same district, and will supply electrical energy to iron works and also power in bulk to the local power-distribution company.

Each steam turbine exhausts into a surface condenser of Willans & Robinson type, each condenser being designed to give a vacuum of 29 ins. with a temperature of circulating water of 60 deg. F.; the quantity of steam to be dealt with at normal load being 45,000 lbs., and about 70,000 lbs. at overload.

One special feature of the plant is the arrangement of relief valves, all the low pressure steam that is not required for doing work in the turbine being by-passed direct into the condenser, so that all the steam output of the blowing engine is returned to the boilers as condensed water.

The condensing plant is fitted with Edwards three-throw air pumps, driven by means of three-phase induction motors through machine-cut gearing. The circulating pumps of the centrifugal type are also driven by low-tension induction motors. The

water for circulating is pumped from the river and forced through 27-in. cast-iron mains to the turbine house, a distance of some 250 yards, the amount of circulating water being about 4500 gallons per minute.

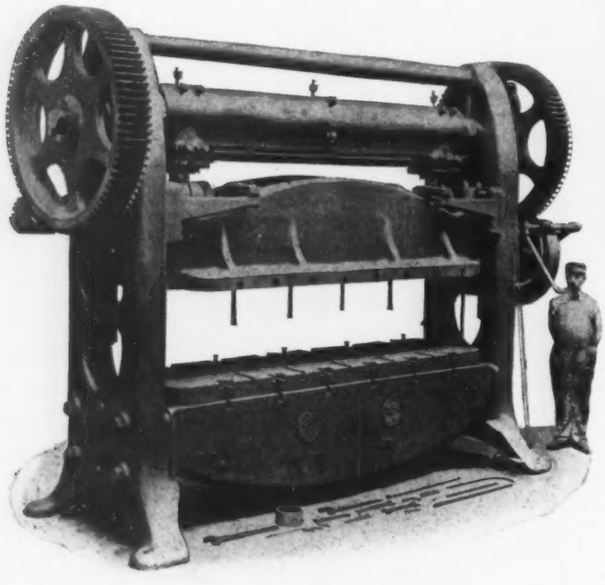
Messrs. Willans & Robinson have also on hand 200-kw exhaust turbines for the South Wales District, the machines being arranged to work in conjunction with heat accumulators, the exhaust steam in this case being furnished by colliery winding engines. Among other sets on hand at Rugby is a 500-kw exhaust turbo-alternator for an iron works and colliery in the Staffordshire district, working in conjunction with a vertical non-condensing blowing machine.

Heavy Power Press for Electrical Work.

The forming of sheet metal requires considerable pressure and when the surface is large or the design deep and intricate or the sheet metal is of an unusually thick gauge the pressure necessary may run into thousands of tons. For the heaviest pressures, hydraulic machinery is indispensable. An objection to hydraulic machinery, however, is that its speed is usually too slow and that the press ram does not come down so definitely to the same point every time as with motor-operated presses.

The press shown in the accompanying illustration is motor-driven and was designed especially for electrical work. A large electrical manufacturing company had been corrugating heavy sheet-iron transformer cases in a hydraulic press which did the work satisfactorily but was very slow. It had recently built for it, by the Ferracute Machine Company, of Bridgeton, N. J., a heavy press to take the place of the hydraulic machine, the new press making 15 strokes per minute, thereby trebling the output.

The construction of the press is comparatively simple, the more apparent features being the heavily trussed bed and ram which reduce the "spring" to a minimum, and the twin gears on the end of the main shaft, which relieve the torsional stress, affording, it is said, an even pressure at both ends, besides dividing the load between the gears. The rods which project down from the ram and up through the bolster are positive



HEAVY MOTOR-DRIVEN PRESS FOR ELECTRICAL WORK.

knockouts, the former being attached to the frame and the latter to the ram.

The adjustment of the ram is attained by means of a bevel-gear and pinion at each end; the pinions being on the same shaft, a construction which insures accurate adjustment. The gears are protected by guards and the eccentric sleeve is fitted with oil-cups. The press is equipped with a "multi-disc" friction clutch and is driven by a 20-hp variable-speed electric motor. The clutch is of the automatic-stop type but can be quickly adjusted for stopping the ram by hand at any point of its decent or ascent, or if desired, can be set for continuous running. The dimensions of the machine are as follows: Distance between columns, 10 ft. 4 ins.; height from bed to ram when up, 28½ ins.; stroke of ram, 9 ins., but any stroke up to 17 ins. can be made if ordered; adjustment of ram, 6 ins.; flywheel, 35 ins. diameter and 6 ins. face; pressure exerted, 200 tons; height of press, 10 ft. 6 ins.; floor space occupied, 5 ft. front to back and 16 ft. right to left. The total weight is 52,000 lbs.

Automatic Oil Switches.

The Hartman Circuit Breaker Company, of Mansfield, Ohio, has recently brought out a light, compact, automatic oil switch for potentials of 3300 volts or less. The switch is of very simple construction, consisting essentially of a double-break knife switch immersed in oil. The parts have been reduced to the least possible number and extreme compactness has been secured by the use of a double-break contact. The overload coils are connected in series with the main circuit, thus dispensing with the use of series transformers. Overload coils to be operated from the secondaries of series transformers can be supplied, however, when desired. The insulation of the series coils has been worked out with great care, and this method can be safely used where the potential does not exceed 2500 volts. One coil is furnished with the double-pole switch and two coils with the three and four-pole switches. The operating lever is made in two parts, which are held together

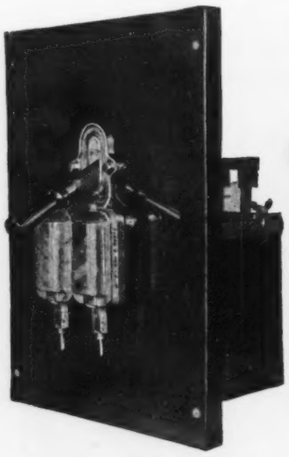


FIG. 1.—SINGLE-THROW AUTOMATIC OIL SWITCH.

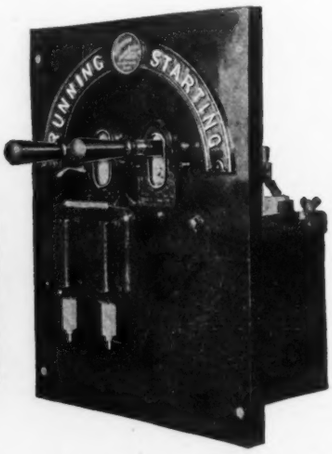


FIG. 2.—DOUBLE-THROW SWITCH AUTOMATIC ON ONE SIDE.

normally by a trigger-shaped catch. This feature prevents the closing of the switch as long as the overload continues, as the inner lever will be instantly disconnected from the outer or handle lever should the attendant undertake to close the switch while overload conditions exist. The switch can be opened by hand by pressing a trigger under the operating lever. The single-throw switch is shown in Fig. 1.

The double-throw switch is made automatic on both sides, which is the standard form, or automatic on one side and non-automatic on the other. The latter form is shown in Fig. 2. This style of switch is frequently furnished for controlling induction motors, the non-automatic or starting side of the switch being connected to the low-voltage taps of an auto-transformer. All double-throw switches are made to interlock, so that it is impossible to close both elements at the same time.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The financial upheaval in New York and other cities affected trade and industry unfavorably, tending to cause wise conservatism in preparations for the future. Current retail trade, however, was generally active and the leading industries kept their machinery busy. An encouraging sign was the absence of cancellations. Transporters were unable to handle promptly all of the freight offered. Recent declines in prices of cereals and cotton have encouraged foreign demand for the country's products. The lumber market was quiet and prices were shaded to stimulate business. Iron and steel were dull. Pig iron continued quiet and prices were weaker. New orders for structural material were of moderate proportions, and steel rails were quiet, the railways being out of the market altogether. Copper found new low levels of prices, lake being quoted as low as 12 cents, and electrolytic for future delivery 11⅝ to 11⅞ cents. Domestic business was light, but shipments to Europe were heavy. Gross and net railway earnings point to the continuance of favorable conditions. The gross earnings for August show a gain of 12.4 per cent, while net gained only 1.4 per cent. The earnings for October thus far show a gain of 6.8 per cent over those of the same period last year. *Bradstreet's* reports 220 business failures during the week ended Oct. 24, as against 194 in the previous week and 184 in the corresponding week last year.

BLOCK SIGNAL EQUIPMENT.—It is stated that the Harriman railroads have undertaken probably the most extensive installation of block signals on record. Some $12,000,000 has already been spent by the present management of the Union Pacific and Southern Pacific for safety appliances, and, with the completion of additional installations already authorized, the two systems will have a total of 5786 miles of automatic signals. According to information compiled in the office of the chief engineer of the company, the Union Pacific now has in operation, all equipped with electric automatic signals, 469 miles of single track and 244 miles of double track. An additional 176 miles of double-track and 197 miles of single-track installation is under construction, and will soon be put into service. More than 300 distant switch signals, protecting the movement of trains toward 158 stations and spurs on the main line of the Kansas and Colorado divisions, have also been put in place. When all the work now authorized and under construction is completed the entire main line of the Union Pacific from Council Bluffs, Ia., to Green River, Wyo., will be protected by automatic signals. The main line of the Kansas Division from Kansas City to Topeka is already equipped with automatic block signals. The remainder of the line into Denver is protected at stations with distant switch signals, as are also the lines between Denver and Cheyenne, and Denver and Julesburg, Col.

THE QUEBEC BRIDGE.—At the huge cantilever bridge over the St. Lawrence at Quebec, which fell down recently while unfinished, electricity was used exclusively for all the hoists, etc. The electrical energy for operating all the motors is generated by the hydro-electric plant of the Canadian Electric Light Company at La Chaudiere Falls, three miles from the bridge, and among the units installed there is a 1000-kw Allis-Chalmers water-wheel type alternator. This current is transmitted as a 2400-volt alternating current to motor-generator sets installed on the approach span to the bridge, where it is transformed to a 550-volt direct current and distributed to all parts of the work. Air for operating the pneumatic hammers, drills, reams, etc., is furnished by two motor-driven, air compressors also placed on the approach span and connected to a 3-in. main running through the center of the bridge, from which branch lines were tapped. The cost of the completed structure was estimated at $10,000,000, of which $5,000,000 had already been spent. The concrete work alone, which has been completed for nearly three years, and for which 40,000 bbls. have been used, cost about $2,000,000.

WESTINGHOUSE EXPORTS.—The export business of the Westinghouse Electric & Manufacturing Company has been unusually flourishing of late, and among the contracts taken by the company, two from the republic of Colombia, South America, are of more than ordinary interest. This work calls for the complete equipment of two city electric lighting plants. One is for the city of Tunja and the other for Bucaramanja. Tunja is located 9000 feet above the level of the sea in the Colombia mountains, while Bucaramanja is located 2000 feet lower down the slope. The electric plant for the former will be steam driven, but at Bucaramanja is a splendid water-power, and the plant will be operated in that manner. A peculiar feature of this mountainous country is that the mule is the only method of transportation, and all the apparatus, boilers, steam engines, electric generators, switchboard appliances, etc., will have to be hauled from the seaport up into the mountains on muleback.

ALLIS-CHALMERS STEAM TURBINES.—Among the noteworthy features of the textile industry this fall has been the ordering of steam turbines of the improved type built by the Allis-Chalmers Company for installation in some of the largest mills of New England and the Central and Southern States. Power machinery of that company's build has long been prominent throughout the country in manufacturing plants of every description, and in the electrification of textile mills, Allis-Chalmers steam turbines and generators, as well as its "induction" motors for alternating current, are now playing a leading part. Contracts recently awarded by textile manufacturers include three turbines for the new 10,000-hp plant of the Pacific Mills, Lawrence, Mass., one of 2200 hp for the American Thread Company's Watuppa Mills, one of 3000 hp for the Tremont & Suffolk Mills and machines of 800 hp each for the Jamestown Worsted Mills and Cherry Cotton Mills.

NEW HAVEN SINGLE-PHASE.—The New York, New Haven & Hartford Railroad is now running its 35 Westinghouse electric locomotives with local trains between the Grand Central Station, New York, and Stamford. The success of the operations involved has exceeded, it is said, the expectations of the officials of the railway company and of the manufacturers, and it is understood that a considerable addition to the locomotive equipment is under negotiation. The New Haven company, it is authoritatively stated, has paid the manufacturers practically in full for the entire work done to date, and continues to pay as the work makes progress. Each locomotive was intended to haul only five-car local trains, but it happens frequently that trains of as many as eight cars are handled with ease by a single unit, and on a recent occasion one of these locomotives pulled a broken-down steam locomotive with its train into Stamford so that a new engine could be attached.

NEW YORK TURBO-GENERATORS.—The rapidity with which the steam turbine has come into popular favor is one of the phenomena of modern steam engineering. It is less than a decade ago since the first turbine was sold in the American market, but there are to-day about 700 in use throughout the country, aggregating a total capacity of approximately 1,000,000 kw, or about 1,500,000 hp. An interesting test conducted recently by the engineers of the New York Edison Company at the Waterside Station, near Thirtieth Street, is said to have developed results hitherto unattained by any steam prime mover in this country. The unit under test was a Westinghouse turbine of 10,000 hp capacity. It had been sold under a steam consumption guarantee of 15.9 lbs. of steam per kw-hour, but the test recorded the phenomenally low steam consumption of a shade less than 14.9 lbs. per kw-hour. The steam consumption figures less than 1½ lbs. of coal per kw-hour.

J. G. WHITE & COMPANY have contracted with the Alliance Gas & Power Company, of Alliance, Ohio, to act as consulting engineers and supervise the purchase and installation of new machinery, consisting of a large turbine generator and a battery of 350-hp boilers, with complete auxiliaries for both electrical and steam ends. The new equipment will be installed in the old plant of the Alliance Gas & Power Company through the winter, and will be transferred later to a new plant, the construction of which will be begun by the engineers early in the spring.

THE TUNGSTEN LAMP IN ENGLAND.—Julius Auerbach, president of the Electrical Accessaries Company, New York City, informs us that he has received advices of the formation in London of the "Tungsten Metal Filament Electric Lamp Company, Ltd." The founders of this company are the International Tungsten Lamp Company, of Budapest, owners of the Just-Hanaman patents; the Auer Company, of Berlin, and the General Electric Company, of London. The new English company has acquired all patents of Dr. Just and Hanaman and of the Ostram Company, and will manufacture lamps in England according to both methods. The capital of the company is $500,000, all fully paid in in cash. The Tungsten Metal Filament Electric Lamp Company, of London, has already started to build a factory, which will have an initial capacity of 10,000 lamps daily. Mr. Auerbach, who represents the European syndicate, the owners of the Just-Hanaman patents in this country, left for Europe on Tuesday to arrange further details with reference to the transfer of the patents to an American company.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, Ohio, has recently moved into a new factory, located on the corner of Marquette Road and Lakeside Avenue. The new building affords a large increase of floor space over the old factory, and a correspondingly larger output will be possible. The new factory consists of one large three-story brick building, in addition to which there is a one-story frame building. The total floor space, including the frame building, is 400 x 200 ft. The power for the factory is generated by three Crocker-Wheeler generators, operated by two Bruce-Meriam-Abbott gas engines, and one steam engine. The ground floor is devoted to rolling, cutting, forming, lead-burning, assembling, etc. On the second floor are located the assembling department and offices. On the third floor, the carpentering and painting departments. The Willard Storage Battery Company will continue in the manufacture of batteries for all purposes.

WESTINGHOUSE, CHURCH, KERR.—Mr. Walter C. Kerr, president of Westinghouse, Church, Kerr & Company, one of the largest construction engineering companies in this country, speaking this week of the work his company is doing at present, stated that they have on hand about 40 contracts, representing some very important construction work. In this work are engaged upward of 100 engineers and about 7000 operatives. One of the largest contracts this company is engaged in is the work of the Pennsylvania Railroad terminal in New York City. Other contracts are for the Erie, the New York, New Haven & Hartford and the Wabash railroads. The amount of money involved in the completion of this work approximates from $25,000,000 to $50,000,000. Mr. Kerr says his company has never been busier than at present and that the outlook for the future is exceedingly bright.

HEAVY ORDER FOR ELECTRIC RAILWAY.—J. G. White & Company, operating managers and purchasing agents for the Eastern Pennsylvania Railways Company, have just ordered $200,000 worth of electric railway material for the Tamaqua and Middleport connecting link between Mauch Chunk and Pottsville. The order includes all the material required for the permanent way and overhead electrical work of a standard interurban railway. Considerable grading has already been done. When the line is finished Pottsville and neighboring towns will be nearer New York in actual time by trolley to Mauch Chunk and the Lehigh Valley Railroad than by the usual railroad detour through Philadelphia.

APPARATUS FOR RUSSIA.—The Central Electricity Station, Vilna, Russia, requests tenders for the supply of one dynamo, one water-tube boiler, 240 m, and one steam turbine, 500 horse-power.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was nervous with frequent fluctuations of an irregular character due to the announcements of failures of minor banks and trust companies. Prices were very irregular, but with good gains from the lowest figures of the week. A feature was the very heavy buying of stocks for investment, particularly in small lots. On Friday the market was very irregular from beginning to end. New low level prices were made by all the electric and traction stocks and some heavy declines are recorded, the heaviest being in Westinghouse, which lost 6¾ points. The quotations of this stock ranged between 106, the highest, and 34½, the lowest, the closing price being 45¾. General Electric fell below par, to 89½, but recovered and closed at 105, which is a net decline of 5 points. American Telephone & Telegraph also dropped below par, closing at the lowest quotation of the week, 96, which is a net loss of 6 points. Following are the closing quotations of Oct. 29:

NEW YORK.

	Oct. 22	Oct. 29		Oct. 22	Oct. 29
Allis-Chalmers Co.	5½	5¼	General Electric	106	105½
Allis-Chalmers Co. pfd..	14½	14⅛	Hudson River Tel.....	—	—
Am. Dist. Tel.....	—	20	Interborough Met. com.	5¼	5¼
American Locomotive..	43½	36	Interborough Met. pfd..	15⅛	15½
Amer. Locomotive pfd..	88¼	84	Mackay Cos.	47	48
American Tel. & Cable..	75	80*	Mackays Cos. pfd.....	52	53
American Tel. & Tel...	—	—	Marconi Tel.	—	—
Brooklyn Rapid Transit.	37⅛	30½	Metropolitan St. Ry...	—	22
Electric Boat	—	—	N. Y. & N. J. Tel.....	—	92
Electric Boat pfd.....	—	—	Western Union Tel....	66	65
Electric Vehicle	—	—	Westinghouse com.....	80½	50
Electric Vehicle pfd....	—	—	Westinghouse pfd.....	—	—

BOSTON.

	Oct. 22	Oct. 29		Oct. 22	Oct. 29
American Tel. & Tel...	99	97	Mass. Elec. Ry. pfd....	38	38
Cumberland Telephone..	—	—	Mexican Telephone.....	5	—
Edison Elec. Illum.....	199	197½	New England Telep....	—	100
General Electric	106⅜	106	Western Tel. & Tel....	—	—
Mass Elec. Ry.....	9	10	West. Tel. & Tel. pfd..	—	—

PHILADELPHIA.

	Oct. 22	Oct. 29		Oct. 22	Oct. 29
American Railways....	45	44	Phila. Electric.....	6½	6½
Elec. Co. of America...	8¼	7⅛	Phila. Rapid Transit...	16¼	16¼
Elec. Storage Battery..	35	33	Phila. Traction	86	85
Elec. Stor. Battery pfd..	—	—			

CHICAGO.

	Oct. 22	Oct. 29		Oct. 22	Oct. 29
Chicago City Ry.....	140	140	National Carbon	—	55
Commonwealth-Edison .	—	79	National Carbon pfd....	—	—
Chicago Subway	15	12	Union Traction	—	—
Chicago Tel. Co.....	—	100	Union Traction pfd.....	—	—
Metropolitan Elec. com.	20*	20*			

*Asked.

THE NATIONAL ENGINEERING CORPORATION, of Baltimore, of which James B. Hoge, of Cleveland, was the head, has been consolidated with the North Electric Company, of Cleveland, and Mr. Hoge has been made vice-president of that company. The capital stock was recently increased from $250,000 to $2,000,000. The National Engineering Company was formed to develop and manufacture what is known as the Clement-Automanual telephone switchboard and has been in existence several years. The system has now been perfected, and it was found that more extended facilities would be needed to manufacture and put it on the market. This system does away with many of the elements of the manual board. One of the principal advantages is that when subscribers' stations are once connected central and all third parties are cut out until either one or the other hangs up his receiver. When parties are through talking and the receivers are replaced on the hooks, the board disconnects the wires automatically and they are ready for other service. When calling the exchange girl presses a button before her, at the same time calling the number back to the subscriber. With this her work ends, as the connection is made with the other line. The board also shows "busy" when a call is made for a line that is in use, and the exchange girl will be excused from calling this back. One of the features about the board is that calls will pass sections where the operators are busy and select one who is not or, at least, this is the claim made for it. A contract has been made for the installation of one of the new boards at Ashtabula, Ohio.

INTERBOROUGH EARNINGS.—The Interborough Rapid Transit Company, of New York, made public last week its statement of earnings for the fiscal year ended June 30, 1907, in comparison with the earnings of the preceding year. The statement showed a gain of $1,475,700.77 in net earnings and of $547,553 in net income, while the surplus earned in the year after the payment of charges and the dividend on the $35,000,000 Interborough stock increased $286,653 over the surplus for the year ended June 30, 1906. The dividends declared on the Interborough stock went to pay the interest on the $70,000,000 Interborough-Metropolitan bonds when received by the holding company as owner of substantially all the stock of the Interborough. That was the only income derived by the Interborough-Metropolitan as holding company, the surplus earnings of the Interborough remaining in its own treasury.

BELL TELEPHONE EARNINGS.—The American Telephone & Telegraph Company reports to the New York Stock Exchange the following income account from Jan. 1 to June 30 as follows: Revenue—Dividends, $5,685,089; rental of instruments, $2,478,497; telephone traffic, $4,228,560; real estate, $37,541; interest, $1,535,531; total, $13,965,218. Disbursements—Expenses of administration, $912,570; interest and taxes, $3,619,792; telephone traffic, $2,336,445; dividends paid, $5,262,056; revenue

balance, $1,834,355; total, $13,965,218. An estimate of the disposition of the proceeds of the company's new issue of stock, just added to the list, is given by the company as follows: For the New England States and Canada, $2,500,000; for the Middle States, $6,000,000; for the Middle Western States, $6,000,000; for the Western States, $3,000,000; for the Southern and Gulf States, $1,500,000; for the purchase of instruments and construction of long-distance lines, $3,000,000.

WESTINGHOUSE RECEIVERS.—The acute financial panic involving stringency in the money market last week was followed by the appointment of receivers for the Westinghouse Electric & Manufacturing Company, the Westinghouse Machine Company, the Securities Investment Company and the Nernst Lamp Company. All the other numerous Westinghouse interests were not disturbed. Judge N. Ewing, Pittsburgh, in the United States Circuit Court, appointed receivers as follows: T. Hart Given, president of the Farmers' Deposit Bank; H. S. A. Stewart, real estate man and financier, and E. M. Herr, vice-president of the company, were named to assume charge of the Westinghouse Electric & Manufacturing Company. William McConway, president of the McConway & Torley Company; W. H. Donner, president of the Union Improvement Company, and E. E. Keller, vice-president of the Machine Company, were appointed receivers for the Westinghouse Machine Company. The Fidelity Title & Trust Company, of Pittsburgh, was named receiver for the Securities Investment Company. Later T. W. Siemon, E. W. Childs and C. H. Hill were appointed receivers for the Westinghouse Lamp Company. For the Nernst Lamp Company W. P. Updegraff has since been appointed receiver. In regard to the situation Mr. Westinghouse has made the following statement: "The necessity for the receiverships is due solely to the acute financial stringency and consequent inability to renew our maturing paper. Both the electric and the machine company are solvent and are doing the largest and most satisfactory business in their history, and each company is earning liberal dividends on its stock and has quick assets substantially equal to its liabilities. I confidently believe that every creditor of each company will be paid in full, and that, with wise management, under the direction of the receivers appointed by the court, the properties will soon be restored to the stockholders. The loans to the Securities Investment Company and myself are secured by the stocks of the Westinghouse manufacturing companies, chiefly stock of the electric and machine companies, the sudden decline in the market value of which on Monday and Tuesday of this week has made it impossible for us to margin our loans. I strongly advise all holders of such loans to hold their collateral, the value of which, I am confident, will in time be sufficient to pay the loans. The sacrifice of the collateral in the present condition of the market can benefit no one. A policy of patience and forbearance is what the situation requires." The Securities Investment Company, whose embarrassment has crippled temporarily the other concerns, is a corporation organized five or six years ago, with a capital of $6,000,000, all of which is owned by Mr. Westinghouse. The company has been accustomed to take securities of corporations to which the manufacturing companies have sold apparatus, paying the manufacturing companies in cash, and itself negotiating the sale of such securities. In addition the Securities Investment Company had been a depositary for a considerable portion of Mr. Westinghouse's personal holdings of stocks, of his own and other companies, and has been the medium through which Mr. Westinghouse has negotiated many of his loans with these securities as collateral. In this trying emergency nothing but warm sympathy and praise are expressed for Mr. Westinghouse, whose leadership as a captain of industry was never more realized than at this moment. The strain put upon his personal finances and those of his corporations is readily understood when it is stated that the business of the Electric Company alone rose from $18,800,000 in 1905 to $38,300,000 this year, and the other companies have enjoyed a similar growth. At the same time it proved impossible to secure from the stockholders all the new capital necessary. It is announced that a plan has been formed to finance the personal obligations of Mr. Westinghouse, the three trustees having been appointed for the securities which he will turn over to secure the payment of loans aggregating $8,000,000. Of this amount $2,500,000 is due Pittsburgh banks, $3,000,000 to New York banks and $2,500,000 to banks in the New England States. Members of the syndicate met with Mr. Westinghouse and signed the agreement by which an extension of three years will be given him. Announcement was also made this week that notwithstanding the receiverships, foreign contracts aggregating $7,000,000 were obtained since the troubles of last week. The British Westinghouse Electric & Manufacturing Company has obtained a $2,000,000 contract to install apparatus at several sub-stations of the Manchester Electric Lighting Corporation and for equipping a lighting station in the East End, London. The Mexican National Railroad has awarded the Westinghouse Electric & Manufacturing Company a contract to equip its big shops at Durango and Monclova. The Rio de Janeiro Tramway, Light & Power Company has also given this company a $4,000,000 contract for the entire outfit of a lighting plant for the big Brazilian capital. Mr. Westinghouse says: "Our shipments for this month are among the largest in the history of the several companies, and additional orders are being received daily. We have about 17,000 men employed at the various plants, and this big force will not be reduced unless conditions materially change. It will be a very short time until all the companies will be released from the receivers."

BOSTON EDISON REPORT.—The twenty-second annual report of the Edison Electric Illuminating Company, of Boston, submitted to stockholders at the annual meeting, for the year ended June 30, 1907, compares with previous years as follows:

	1907.	1906.	1905.	1904.
Gross	$4,020,620	$3,780,911	$3,346,027	$3,125,516
Expenses	2,569,657	2,410,485	2,143,106	2,009,691
Net	$1,450,963	$1,370,426	$1,202,921	$1,115,825
Misc. profit	41,340	49,256	33,285	37,396
Total net	$1,492,303	$1,419,682	$1,236,206	$1,153,221
Int. and divs.	1,406,700	1,227,776	1,164,790	1,075,813
Surplus	$85,603	$191,906	$71,416	$77,408

Included in expenses this year are taxes amounting to $453,479, compared with $445,508 the previous year and $366,450 two years ago.

Lamps and motors connected as of date June 30 compare as follows:

	1907.	1906.	1905.	1904.
Incan. lamps	863,313	788,560	708,384	627,441
Arc lamps	10,339	10,534	10,102	9,358
Motors, hp.	35,095	30,432	26,416	24,150

As no new properties were absorbed during the past year, the above table shows only the increase which the company obtained through its regular growth. It is by far the largest in the history of the company. The balance sheet as of date June 30 compares as follows:

ASSETS.

	1907.	1906.	1905.	1904.
Installation	$19,440,047	$18,161,329	$17,545,113	$16,251,146
Cash on hand	1,590,897	133,873	213,711	135,339
Stock on hand	458,766	403,078	447,407	409,342
Notes and Accts. Rec.	1,847,689	1,780,421	1,856,075	1,757,471
Open accounts	78,859	9,208	49,633	78,130
Sinking funds	26,128	23,914	20,594	.....
Total	$23,442,388	$20,511,823	$20,132,536	$18,631,429

LIABILITIES.

Capital stock	$12,643,600	$11,488,100	$11,488,100	$10,444,500
Mortgage bonds	1,485,000	1,486,000	1,486,000	1,342,000
Notes and Accts. Pay.	1,753,100	1,483,029	1,012,096	1,314,805
Dividend payable	442,526	287,202	287,202	261,112
Res. for Maintenance.	238,438	95,114	341,201	806,930
Premium on new stock.	6,501,170	5,307,150	5,307,150	4,261,250
Accrued Int. & taxes..	64,132	89,355	68,253	84,511
Replacing account	24,311	9,962	19,023	4,644
Coupon notes	49,000	52,500	56,000	59,500
Profit and loss	241,108	213,409	67,509	52,174
Total	$23,442,388	$20,511,823	$20,132,536	$18,631,429

DIVIDENDS.—The American Light & Traction Company has declared the regular quarterly dividend of 1¼ per cent on the preferred stock and 1½ per cent on the common stock, payable Nov. 1. Directors of the Electrical Securities Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable Nov. 1. Directors of the Multiphone Operating Company have declared the regular monthly dividend of 1 per cent, payable Nov. 1 to stockholders of record Oct. 25. The J. G. Brill Company has declared a dividend of 1¾ per cent on its preferred stock and 1 per cent on its common stock. The preferred is payable Nov. 1. The common is payable Dec. 14. The directors of the New England Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent, payable Nov. 15. Directors of the American Gas & Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Nov. 1.

GENERAL NEWS

Construction News.

ENSLEY, ALA.—It is reported that the Ensley Street Railway Company, which was organized to construct a street railway system in Ensley, will construct and operate an electric light plant. J. J. Waller is president.

HUNTSVILLE, ALA.—Messrs. Denham and Dupont, of the Huntsville Railway, Light & Power Company, have been in the city recently making investigations of the condition of the power plant and the local electric street car stystem. It is stated that they will recommend the construction of a new power house and that the street railway system be extended. The improvements contemplated will involve an expenditure of about $50,000. Francis N. Lawton is general manager.

CALAMINE, ARK.—The Arbuckle Mining & Milling Company, which is building a dam across Strawberry River, 5 miles from Calamine Mine, will develop 525 horse-power. The equipment of the plant will consist of generators and transformers for 6600 volts. Electricity will be transmitted to operate a 200-ton concentrating plant for zinc and lead ores being developed by the company near Calamine, 5 miles west of the dam. Machinery and transmission lines have not yet been purchased. D. A. Estill is president and W. H. Vaughn, general manager; E. S. Merkle, of Imboden, is engineer and has charge of the work and purchasing of the machinery. The company next year will build a dam at Imboden, on Spring River, and construct a hydro-electric plant and develop 800 horse-power.

CALISTOGA, CAL.—The City Trustees have granted a franchise to Henry Brown to construct and operate an electric light, heat and power system.

FRESNO, CAL.—The City Trustees will receive bids until Nov. 18 for a light and power franchise as applied for by the Fresno Home Light & Power Company.

LOS ANGELES, CAL.—The City Council has awarded the contract for an electric generator and transformers for the Cottonwood Creek hydro-electric plant to the Westinghouse Electric & Manufacturing Company for $18,039.

NAPA, CAL.—Machinery to be used in the new cars and power houses of the Vallejo, San Francisco & Napa Valley Electric Railroad has arrived. The poles and wires for the transmission lines are now being erected.

NEEDLES, CAL.—Carl F. Schrader has petitioned the Board of Supervisors at San Bernardino for a franchise to operate a gas and electric system at Needles. He will secure electricity from the Victor & Virgin Mining Company and will install a gas plant.

OAKLAND, CAL.—The Southern Pacific Company has notified the City Council of the withdrawal of its application for permission to change the Webster Street line into Oakland from steam to electricity.

REDLANDS, CAL.—The Pacific Telephone & Telegraph Company has decided to make many changes and improvements to the local telephone system. The entire exchange will be supplanted by a new one of later design, and new equipment will be installed where needed. O. Cole, of San Francisco, is superintendent.

SAN DIEGO, CAL.—It has been announced that the San Diego, Cuyamaca & Eastern Railway Company has secured an option on the electric car line which circles the water front. It is proposed to electrify the Cuyamaca road at some future time. E. S. Babcock is president of the company.

SAN FRANCISCO, CAL.—The Central California Power Company has filed a mortgage deed on its water and land rights, also its plant, in trust to the California Safe Deposit & Trust Company to secure an issue of $5,000,000 in bonds.

SAN FRANCISCO, CAL.—It has been announced in Washington, D. C., that the Forestry Bureau has granted to the Southern Pacific Company a permit to build a power house and conduits in the Cascade National Forest Reserve in Oregon. This recalls announcements regarding the purpose of Mr. Harriman to electrically equip the Pacific roads in the mountain regions and is probably in line with those plans, although in the face of his recent retrenchment orders it is not probable that active work will be done just now.

SAN JUAN, CAL.—The Stanislaus Power Company is making surveys for its transmission line to run from the Joaquin to the cement plant in this town.

COLEBROOK, CONN.—The Colebrook Manufacturing Company, (mail, telephone and telegraph address Winsted) writes that it is in the market for a full steam and water power electric transmission equipment and wood-working machinery for light work and specialties.

HARTFORD, CONN.—The stockholders of the Hartford Electric Light Company on Oct. 23 voted to accept the act recently passed by the Legislature authorizing it to increase its capital stock to $5,000,000. The company now has an outstanding capitalization of $2,100,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Nov. 12, to furnish at the navy yards and naval stations the following supplies: Brooklyn, N. Y., schedule 449—steam disinfecting plant. Pensacola, Fla., schedule 438—8000 lbs. ingot copper, etc. New Orleans, La., schedule 435—electrical supplies. Bids will also be received until Nov. 19 as follows: Pensacola, Fla., schedule 448—one motor-driven rotary or centrifugal pump; four transformers and four motor-generator sets; erecting complete one hot water heating system. California City Point, Cal., schedule 450—50-kw generating set. Norfolk, Va., schedule 445—twelve 2-ton trolley hoists; one motor-driven drilling, boring and milling machine. Portsmouth, N. H., schedule 446—one motor-driven pipe-threading machine, one engine lathe. Applications for proposals should designate the schedule desired by number. E. B. Rogers, paymaster-general, U. S. N.

PALMETTO, FLA.—John A. Graham has been granted a franchise to furnish electricity for lighting in this town.

ASHBURN, GA.—The citizens on Oct. 20 voted in favor of issuing $50,000 in bonds, $45,000 of which is to be used for the erection of an electric light plant and water works system. Work will commence on construction of the plant as soon as the bonds are sold.

ATLANTA, GA.—A petition has been filed in the United States Court to place the Southern States Electric Company in the hands of a receiver.

MACON, GA.—The State Railroad Commission on Oct. 17 approved the proposed issue of $150,000 in capital stock which the Bibb Power Company, of this city, proposes to issue. This company has just been organized, and plans to develop certain water powers in Bibb County to supply electricity for lamps and motors in Macon. It is also expected that the company will supply electricity to the new interurban electric railway soon to be built.

MACON, GA.—The Citizens' Electric Company has applied to the City Council for a franchise to furnish electricity for lamps and motors in the city of Macon. The company proposes to furnish electricity to the citizens of Macon for lighting purposes at 10 cents per kw-hour and 8 cents per kw-hour for manufacturing purposes and will allow 10 per cent discount for all bills paid before the 10th of the month. W. A. Burney, of Savannah, is at the head of the company. The capital stock of the company is placed at $100,000.

MADISON, GA.—Moses Cohen, city clerk, writes in regard to the construction of an electric light plant, water works and sewerage system for which the citizens were recently reported to have voted to issue $85,000 in bonds, that contracts have been awarded and the work has been under way for about three months.

WAYCROSS, GA.—The Waycross Electric Light & Power Company is planning to install additional machinery to increase the capacity of the ice plant. J. E. Wadley is president and manager.

CHICAGO, ILL.—It is reported that all bids received on Oct. 15 by City Electrician Carroll for 2500 lamps and their equipment have been rejected and new bids will be received. Four bids were received, all bidders submitting the same price, a total of $84,395.

MOLINE, ILL.—The People's Power Company is installing a large turbine engine in its power plant at the foot of Fourth Street in this city.

ROCKFORD, ILL.—The Third National Bank, of this city, is preparing to install an electric light system in the new addition to the building now being erected to furnish light for the entire building.

DECATUR, IND.—We are informed that the Illinois Traction Company has purchased all the apparatus required for the present year, with the exception of an exhaust base turbine condenser for a 3000-kw turbine, three 1000-kw transformers and switchboard apparatus for a turbine of 3000-kw capacity. H. C. Hoagland is electrical engineer.

GARY, IND.—The Town Board has granted a fifty-year franchise to the Chicago Telephone Company to erect a telephone system in the town. The company proposes to erect a plant at a cost of $500,000.

HAGERSTOWN, IND.—The Town Board has passed an ordinance authorizing the issue of bonds, the proceeds to be used in the procuring of an electric light plant recently voted for by the citizens of the town. Plans and specifications for the new plant have been ordered.

HUNTINGTON, IND.—A large number of citizens have petitioned the City Council to grant the Fort Wayne & Wabash Valley Traction Company the franchise, recently applied for by the company, to furnish electricity in the city. The company proposes to transmit electricity from Fort Wayne to Huntington and to utilize its old power house in this place for a sub-station. The company states that it will sell electricity at a lower price than that now charged by the local company.

INDIANAPOLIS, IND.—The Grand Central Traction Company, which is preparing to construct an electric railway from Indianapolis to Evansville, has applied to the Board of Public Works for two franchises to enter the city.

KNIGHTSTOWN, IND.—The City Council has passed an ordinance providing for an issue of $12,000 in bonds for the purchase of new machinery, boilers and equipment for the electric light and power house.

LAFAYETTE, IND.—A franchise has been granted by the Commissioners of Tippecanoe County to the Chicago & Western Indiana Traction Company to construct and operate an interurban railway through Fairfield, Wea and Randolph townships in Tippecanoe County. The franchise is for 50 years and stipulates that the company must provide its own bridges and also prohibits operation by steam.

WASHINGTON, IND.—The City Council has passed a resolution asking that an ordinance be prepared looking to the disposal of the municipal electric light plant.

MUSKOGEE, I. T.—Contracts have been awarded by the Bartlesville Interurban Company for grading its line between Bartlesville and Dewey, a distance of four miles. Contracts for bridges and trestles have been awarded. Joseph J. Curl, president of the company, is now in the East contracting for the equipment of the road.

KANSAS CITY, KAN.—The Bradley-Alderson Implement Company has purchased a site in Rosedale and will erect a new building at a cost of $50,000. Two electric elevators will be installed. J. Oliver Hogg New York Life Building, Kansas City, Mo., is the architect.

LIBERAL, KAN.—The Liberal Light, Ice & Power Company has placed contracts for the construction of an electric light and ice plant. The main power house will be 60 x 65 feet, and the boiler house 32 x 42 feet. The equipment of the plant will consist of two 100-kw, three-phase, 60-cycle, 2300-volt generators; a 14 x 36 in. Corliss engine, built by the Murray Iron Works, Burlington, Ia., and a 100-hp Lycoming high-speed engine; one 50-hp, three-phase motor for compressor, circulating pumps driven by a 10-hp motor, and boiler feed and other pumps, also motor driven. The company is planning to install a machine shop later on, for which new equipment of machine tools will be required. J. W. Tyner is superintendent.

LATONIA, KY.—The City Council has granted a franchise to the Kentucky Electric Company for a term of thirteen years in accordance with the proposition recently submitted to the Council. The company agrees to furnish any number of arc lamps for the first three years at $60 per lamp per year and during the remaining ten years for $58 per lamp per year; incandescent lamps of 32 cp at $24 each per year; electricity for commercial purposes, 10 cents per kw-hour, less 15 per cent discount for payment within ten days; for motors and heat, 10 cents per kw-hour, less 20 per cent discount for payment within ten days after date of monthly bill.

EUNICE, LA.—The City Council has granted a franchise to Charles Lauve, of Franklin, for an electric light plant. The plant will cost about $30,000 and will furnish electricity to light the streets, business and private houses and for fan service. Warren B. Reid, of New Orleans, will be associated with Mr. Lauve in the construction of the plant.

PIONEER (P. O. FLOYD), LA.—The Pioneer Cooperage Company is installing an electric light plant and water works.

MILLINOCKET, MAINE.—The large dam of the Great Northern Paper Company at the Dolby Rips, on the Penobscot River, has been completed and will soon be put into service. This dam will furnish power to operate the large electrical plant of the Great Northern Paper Company, which will furnish electricity to operate the grinders and other machinery in the new pulp mill at East Millinocket and the old mill in Millinocket, and also for lighting both towns. It will also furnish power for a ground wood pulp mill, which will be located at Dolby.

PRESQUE ISLE, MAINE.—The new water plant of the Maine & New Brunswick Electrical Power Company, located at the falls on the Aroostook River, was formally opened Oct. 17. The plant will furnish electricity to be used in New Brunswick and Maine towns along the border. The plant has a capacity of 15,000 horse-power, and will be ready to furnish electricity in Presque Isle about the middle of November. James D. Seely, of St. John, N. B., is secretary of the company.

BALTIMORE, MD.—The Board of Awards on Oct. 18 rejected all bids recently received for a dynamo to be installed in the Eastern High School, and will receive new bids.

AYER, MASS.—The Ayer Electric Lighting Company is now furnishing a 24-hour service. Several firms have installed motors to operate their machinery. In order to meet the increased demand for electricity the company has increased the capacity of its plant, adding 200 horsepower in machinery to its equipment.

BOSTON, MASS.—The Boston & Worcester Street Railway Company has petitioned the State Railroad Commission for permission to issue $50,000 additional capital stock.

BOSTON, MASS.—E. Moody Boynton, inventor of the bicycle railway and promoter of the proposed railway to be known as the Boston, Quincy & Fall River Railway, has applied to the Board of State Railroad Commissioners for authority to issue $500,000 in capital stock and $500,000 in bonds. If permission is granted it is proposed to construct ten miles of the road between Quincy and Brockton, starting with this as a section, and eventually to construct the whole line between Boston and Fall River.

FALL RIVER, MASS.—Mayor Coughlin has signed the new contract with the Fall River Electric Light Company, which will result in a saving of about $14,000 annually.

FITCHBURG, MASS.—The directors of the Fitchburg Gas & Electric Light Company have announced a reduction in the rates for electricity for lighting amounting to about 25 per cent. In addition to the material cut in incandescent and arc lamp rates, a special 5-cent rate for outside sign and decorative lighting has been established. Under the new schedule the base rate is 16 cents per kw-hour, with 10 per cent discount on all bills paid before the 20th of each month. The old schedule was on a base of 20 cents per kw-hour, with a varying scale of discounts in proportion to the amount used. The new schedule is as follows: For the first 100 kw-hours used per month, 16 cents; for the next 200, 12 cents; for the next 300, 10 cents; for next 400, 8 cents, and all over 1000 kw-hours used, 7 cents. For arc lamps, the minimum monthly charge will be according to the length of the contract, as follows: One year or more, $2 per month per lamp; six months or more, $3 per lamp per month; three months or more, $5 per month per lamp. A minimum charge of $1 per month will be made for each meter set. Conditions under which a flat rate of 5 cents per kw-hour for all outside decorating and sign lighting is given are: All such lighting shall be connected by an independent meter to be located by the company, and all wiring shall be placed in an iron conduit. The customers shall agree to burn these lamps not less than nine hours a week for the months of June, July, August and September, 15 hours a week for the months of October, November, December and January, and 12 hours a week for the months of February, March, April and May. These hours of burning shall constitute a minimum monthly charge to be made the customer based on the amount of lighting contracted for.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company is erecting an addition to its power plant to meet the increasing demands for electricity for lamps and motors. A new 500-kw General Electric generator and a 750-hp cross-compound McIntosh & Seymour engine will be installed. The company is building a pole line to transmit electric energy from the plant of the Turners Falls Company. A new storage battery is to be installed at Cheapside to take the place of the one that has become obsolete. The company has practically reconstructed its line in the village, which has resulted in a great improvement to the service. J. W. Stevens is president of the company.

LEICESTER, MASS.—The control of the Rawson Electric Light & Power Company has passed into the hands of the Worcester Electric Light Company. The Worcester company will operate the system from its plant in Worcester and establish a 24-hour service. A. B. R. Sprague is president.

MERRIMAC, MASS.—The citizens are considering the proposition of installing an additional dynamo and engine in the municipal electric light plant to meet the increased demands made on the plant to furnish electricity for lighting purposes.

NORTHBORO, MASS.—The Selectmen have received a notice from the Blair Light Company, which has been lighting the streets of the town at a cost of $1,750 a year, that after Nov. 1, unless a contract be agreed upon, it will have to charge the town $10 a night for lighting the streets, which would cost $210 per month, making a total of $2,520 per year. The Selectmen in reply have notified the company that its services would not be needed after Nov. 1, as other arrangements have been made for lighting the town.

SPRINGFIELD, MASS.—The United Electric Light Company has petitioned the State Gas and Electric Light Commissioners for approval of an issue of capital stock to realize $750,000 to retire its floating debt and additions to floating debt.

ALLEGAN, MICH.—F. Littlejohn and associates have applied for a franchise to erect and operate an electric power plant in this city. Energy will be secured from the Commonwealth Power Company. It will be sold on a flat rate basis. There is already an electric company operating in the city.

BYRON, MICH.—The Village Council has granted a twenty-year franchise to the Shiawasse Light & Power Company to light the village with ten arc lamps.

CADILLAC, MICH.—Surveys are now being made by the Electric Land & Development Company for railway spurs to the site of the first dam. Chief Engineer Hubbell states that it will require fourteen months to build this dam, one of the five to be built by the company. The construction of the first dam is associated with the project for constructing an interurban road from Traverse City to Charlevoix. The proposed electric road is to be built by the Carter Construction Company, which has already placed an order for 60,000 steel rails. The cost of the road is estimated at $15,000 a mile.

CADILLAC, MICH.—The Manistee River Power Company has been organized with a capital stock of $1,000,000 for the purpose of developing power on the Manistee River. As soon as the organization is perfected contracts for construction will be given out, preliminary work will be commenced this fall and heavy construction work in the spring on the first dam. The first dam, developing 5000 hp, will be built in Greenwood township. The company will construct four dams on the Manistee River with a capacity of 20,000 hp. The transmission lines from the first dam will run to Cadillac, Elk Rapids and Traverse City.

FLINT, MICH.—Detroit capital, represented by Joseph W. Martin, has presented a petition to the Common Council for a franchise for a new telephone system. The ordinance provides that the company be allowed to erect and operate a system for a period of thirty years. It is understood that the proposed system will operate in connection with the new grange system.

ESCANABA, MICH.—The Escanaba Electric Pulp & Power Company is now building a dam at Flat Rock, two miles from the city, which it expects to have completed and ready for operation by Jan. 1. The com-

pany was recently granted a franchise to furnish electricity to operate the municipal electric light plant, and also for commercial lighting and power purposes in this city for a term of ten years. P. L. Utely, of Watertown, Wis., is secretary and treasurer.

IRON RIVER, MICH.—A. J. Lytle and F. A. Morrison are contemplating the purchase of machinery for an electric light plant consisting of boiler, engine, dynamo and other equipment.

IRON MOUNTAIN, MICH.—Contracts have been placed by the Iron Mountain Electric Light & Power Company for extensive improvements to its plant. The new equipment will include a new 150-kw generator with switchboard, etc. The street lighting system will be improved by the installation of new lamps of 2000 cp, and of improved design. The company will establish a 24-hour service when the improvements are completed. The improvements contemplated will involve an expenditure of about $10,000.

NEGAUNEE, MICH.—Work has commenced on improvements to the plant of the Marquette County Gas & Electric Company in this place, for which the machinery has been ordered. A new 500-kw turbine and generator have been purchased and will be installed in the electric light plant. A direct-connected engine and generator has also been ordered to operate the street railway system. A large storage battery will be provided for the latter to carry the excess load of the railway. A new 300-hp Babcock & Wilcox water-tube boiler will be installed, but the four boilers now in use will be retained for the present. Later two of the boilers will be abandoned and another 300-hp boiler installed in their place. An addition 43 feet in length will be built to the boiler house. W. J. McCorkindale, of Ishpeming, is manager.

TRENTON, MICH.—The Village Council is considering the proposition to sell the electric light plant and water works to the Detroit Illuminating Company to be continued under a ten-year contract.

BURLINGTON JUNCTION, MO.—The Burlington Junction Electric Light & Power Company, recently incorporated, will erect a one-story brick power house at a cost of $1,000, and will install machinery, including a gas-producing plant, at a cost of about $8,000. An engineer has not yet been engaged. D. T. Garrett and others are interested in the company.

CAMPBELL, MO.—A. C. Morse, proprietor of the local electric light plant, is planning to organize a stock company, to be composed of business men of Campbell, St. Louis and Cairo, to increase the present capacity of the plant and to install an ice plant later on. It is proposed to install a new 150-kw alternator, a Corliss engine of 150 hp, a 150-hp tubular boiler and a 10-ton ice plant.

MAYSVILLE, MO.—The citizens are considering the question of holding an election to vote on the proposition of issuing $10,000 in bonds to construct an electric light plant.

HELENA, MONT.—The Montana Electric Company has filed a certificate showing an increase in its capital stock from $100,000 to $250,000.

KALISPELL, MONT.—The Flathead Valley Water Power Company purchased the property of the Big Fork Electric Light & Power Company in January, 1907, and is building an entirely new plant. The water power plant is located in Big Fork, Mont., at the junction of the Big Fork River and Flathead Lake. The new plant will contain 500-kw, 60-cycle, three-phase, 2200-volt, 514 r. p. m. Westinghouse alternators and step-up transformers delta connected to step the voltage from 2200 to 33,000. The company now has under construction 19½ miles of transmission line and a new sub-station at Kalispell. The sub-station will be equipped with step-down transformers, from 33,000 volts to 2200 volts, all three-phase work. The old plant and transmission line will be abandoned when the new plant is completed and the old generators will be rewound to three-phase, 2200 volts and run in parallel with the new plant. The plant is owned by Howard, Simmons & Company, of Chicago, Ill., of which H. M. Byllesby & Company are engineers, managers and part owners. O. A. Farrar is manager.

GENEVA, NEB.—The Geneva Electric Company is making arrangements to enlarge and improve its plant and has placed orders for a 100-hp boiler and an engine of 175 hp to be installed in the plant.

STELLA, NEB.—It is reported that an electric light plant will be installed in this place.

UNIVERSITY, NEB.—The Council is considering the proposition of purchasing electricity for operating the municipal electric lighting plant instead of erecting a new power house.

PATERSON, N. J.—The directors of the Paterson Heat, Light & Power Company have voted to dissolve the corporation. The company was formed with the intention of erecting a plant to furnish gas and electricity in opposition to the Public Service Corporation. As the city a few months ago made a new contract with the Public Service Corporation at a cheaper rate, and the commissioners did not favor the wholesale tearing up of improved streets, the corporation deemed it best to close up its business.

NEW PALTZ, N. Y.—The Electric Light Company of New Paltz is planning to change its system from 133 to 60 cycles and to connect its system with the Poughkeepsie Electric Light, Heat & Power Company or with the Honk Falls Power Company and will furnish a 24-hour service. The company will also install a 15-hp single-phase motor. S. L. Johnston is treasurer and manager.

NEW YORK, N. Y.—The contract for installing electric equipment in addition to and alteration in School 59, Borough of Manhattan, was awarded by C. B. J. Snyder, superintendent of schools, on Oct. 21, to T. Fred. Jackson, Inc., 592 Columbus Avenue, for $7,250.

NIAGARA FALLS, N. Y.—The Niagara Falls Lighting Company has been granted a franchise by the City Council.

ROSYLN, N. Y.—The Nassau Light & Power Company has applied to the Public Service Commission for permission to issue $532,000 in capital stock and $1,000,000 in bonds and also for authority to purchase the capital stock of the Oyster Bay Light & Power Company.

STUYVESANT FALLS, N. Y.—The Collins Bag Company, of New York City, has leased the old Van Alen mills in this place and is making improvements to the plant. New buildings are to be erected and an electric plant will be installed.

HAMLET, N. C.—An electric lighting plant will soon be placed in operation in this town. J. A. Williams is owner.

HENDERSONVILLE, N. C.—The Board of Aldermen has ordered that bids be invited for furnishing thirty or more 1200-cp electric lamps for lighting the streets of the city. The present contract expires Dec. 1. The company securing the contract for the street lighting will have the privilege of supplying electricity for domestic and commercial use. Michael Schenck is Mayor.

LINCOLNTON, N. C.—The Newcome-Maury Company, of Atlanta, Ga., has been awarded the contract for the equipment of the new electric light plant. The Southern Power Company will supply the power for the plant.

NEWTON, N. C.—The Southern Power Company has completed its transmission line to Newton, 90 miles west of the principal hydro-electric plants, and will erect a sub-station here at a cost of $10,000.

SALISBURY, N. C.—The Whitney Power Company has selected Salisbury as the distributing point for its 45,000-hp plant being erected on the Yadkin River, 30 miles distant. It is expected to have the plant in operation by July, 1908.

SMITHVILLE, N. C.—The committee, recently appointed by the Town Commissioners to secure estimates on the cost of constructing an electric light plant, water works and sewerage system, is inviting plans, specifications and estimates on the construction of an electric light plant. N. M. Lawrence, Jr., N. B. Grantham and F. H. Brooks are members of the committee.

THOMASVILLE, N. C.—The Thomasville Light & Power Company has been granted a franchise to furnish electricity to light the town. It is proposed to erect a plant at a cost of $20,000 and furnish a 24-hour service. B. F. W. Bryant, of Boston, Mass., is interested in the project.

WILMINGTON, N. C.—Final negotiations in connection with the transfer of the control of the Consolidated Railway, Light & Power Company to the Tidewater Power Company have been made. The Consolidated Company has been taken over by the Tidewater Power Company under a lease for ninety-nine years.

ALLIANCE, OHIO.—The Alliance Gas & Power Company has contracted with J. G. White & Company, of New York, N. Y., to act as consulting engineers and supervise the purchase and installation of new machinery, consisting of a large turbine generator and a battery of 350-hp boilers, with complete auxiliaries for both electrical and steam ends. The new equipment will be installed in the old plant of the Alliance Gas & Power Company through the winter, and will be transferred later to a new plant, the construction of which will be begun by the engineers early in the spring.

BRYAN, OHIO.—The City Council has passed an ordinance to issue bonds for enlarging and improving the municipal electric light plant and water works system. New machinery will be added to the plant and new street lamps will also be installed.

CINCINNATI, OHIO.—Contracts will soon be awarded for rewiring the old City Hospital Building. The cost of the work is estimated at about $7,000. Elzner & Anderson are the architects.

ELYRIA, OHIO.—The City Council has granted the Cleveland, Southwestern & Columbus Railway Company a 25-year franchise for a belt line around the town and the old franchise has been extended for the same length of time.

ELYRIA, OHIO.—The Elyria Milling & Power Company has secured the contract for lighting the city for ten years at $64 per lamp per year. The bid of the Citizens' Gas & Electric Company, which has the present contract for city lighting, was $67.50 per lamp per year. The new company is to use water power in generating electricity. G. N. Arnold is president.

NEWBURGH HEIGHTS, OHIO.—Bids will be received until Nov. 18 at the office of P. S. Ruggles, village clerk, for lighting the streets of the village.

PORTSMOUTH, OHIO.—The Knox-Dickey Telephone Company is preparing to enlarge its plant at Second and Jefferson Streets with a view of branching out on an extensive scale.

YOUNGSTOWN, OHIO.—The lighting committee of the City Council has decided to report favorably on the proposition for a municipal electric lighting plant.

BAKER CITY, ORE.—Work has commenced on the right of way from the power station of the Baker Light & Power Company to the mines at Bourne. The company has contracted to furnish electricity for mining and milling in the Bourne district and expects to finish the project this winter. The company has completed its transmission line to the "Uncle

Dan" mine east of the city, and is now furnishing power for operating the machinery in the mine and for lighting. J. L. Lambirth is manager.

PANAMA.—Bids will be received until Nov. 19 at the office of H. F. Hodges, general purchasing officer, Isthmian Canal Commission, Washington, D. C., for electrical fixtures, conductor, wire, wrought iron, steel tubing, etc., as per circular No. 399.

BUTLER, PA.—The People's Telephone Company has arranged to issue $40,000 in bonds, the proceeds to be used for extension purposes.

DUBOIS, PA.—The Borough Council has awarded the contract for street lighting to John E. Dubois for a term of five years.

HARRISBURG, PA.—The Central Pennsylvania Traction Company is planning to extend the double track of its Paxtang line from this city to Paxtang this fall. Negotiations are now under way with the company and the Pennsylvania Railroad Company for the use of the old canal towpath for the extension to Dauphin.

HARRISBURG, PA.—The State Water Supply Commission has approved the applications for charters of the Iroquois Power Company and the Watts Power & Water Company. Both companies have recently made large purchases and propose to build large power plants to develop the water power of the Juniata River and generate electricity for lighting and motor purposes.

MAUCH CHUNK, PA.—J. G. White & Company, operating managers and purchasing agents for the Eastern Pennsylvania Railways Company, has placed orders for $200,000 worth of railway material for the Tamaqua & Middleport extension, connecting link between Mauch Chunk and Pottsville. The order includes all material required for the permanent way and overhead electrical work of a standard interurban railway.

MILLERSBURG, PA.—The stockholders of the Hegins-Millersburg Electric Railway have decided to commence work on the construction of the line.

PARSONS, PA.—The Borough Council has passed an ordinance granting the Wilkes-Barre & Plains Street Railway Company permission to construct and operate a railway on Main and Mill Streets.

WOMELSDORF, PA.—W. W. Lengel, borough secretary, writes that the contract for the construction of a municipal electric light plant has been awarded to the Reading Electric Company, of Reading, for $11,275. F. W. Darlington, Philadelphia, Pa., is the engineer.

PROVIDENCE, R. I.—Plans are being considered for the construction of a large addition to the Manchester Street power house.

ARMOUR, S. D.—The City Council has entered into a contract with the Wagner, Lake Shore & Armour Traction Company, which is installing an electric light and power plant in this city, to install four 1200-cp arc lamps at $6 per month.

CHARLOTTE, TENN.—The citizens are considering the question of issuing $5,000 in bonds for the construction of an electric light plant. Address Mayor Taylor.

SOUTH PITTSBURG, TENN.—It is reported that the municipal electric lighting plant, which has been in operation about a year, has proved a failure and is now on the market for sale.

BRENHAM, TEX.—The Southwestern Telegraph & Telephone Company is contemplating moving into another building and will install entirely new equipment.

ELGIN, TEX.—Mr. Graham, of Smithville, is contemplating the construction of a light, water and ice plant in this place at a cost of about $60,000.

MIDLAND, TEX.—The Midland Light & Ice Company, which was recently incorporated, is planning to install an electric light plant. George D. Elliott is president of the company.

McKINNEY, TEX.—An election will be held in November to vote on the proposition to issue $8,000 in bonds to improve and enlarge the municipal electric light plant.

MARBLE FALLS, TEX.—C. H. Alexander, of Dallas, Tex., who recently purchased the water power property at Marble Falls, is contemplating the construction of a 10-ft. dam on top of the present natural dam to provide for generating additional power to be transmitted by electricity for operating manufacturing plants.

BIG STONE GAP, VA.—The electric plant of the Wise Electric Company has been purchased by the Powell Valley Light & Power Company, which was recently incorporated. The new company proposes to improve and enlarge the plant. The officers are: R. A. Morrison, president and general manager, and J. B. Ayers, secretary and treasurer.

WAYNESBORO, VA.—We are informed that the local electric light plant, which was recently damaged by fire, has been sold to Gardner & Quarly, of Basic City, who are arranging to put in a new plant.

CHEHALIS, WASH.—The City Council has granted the Centralia-Chehalis Electric Railway & Power Company a franchise to operate an electric railway in this city and between the city and Centralia. B. J. Weeks and associates are interested in the company.

SPOKANE, WASH.—The lighting contract between the city and the Washington Power Company has been signed by the officials of the city and the president and secretary of the company. By the terms the company is to supply the city with 525 lamps at an annual rate of $48 each for a period of five years.

STEVENSON, WASH.—H. C. Eckensberger, general freight agent at Portland for the New York Central lines, has filed water rights, appropriating 10,000 cu. ft. of water per second at the Upper Cascades, on the Columbia River, to be used for power and manufacturing purposes. It is said that the project contemplates the construction of a power plant of 30,000 hp.

TACOMA, WASH.—The City Council has voted to award the contract for furnishing electric power to the city for the next five years to the Seattle-Tacoma Power Company at the rate of 1¼ cents per kw-hour. The contract is for 5000 hp.

EAU CLAIRE, WIS.—We have been informed by the Northwestern Lumber Company, of Eau Claire, that the company has no definite plans as yet for building its dam on the Eau Claire River. It has been buying flowage rights and will probably build a dam within a year or two.

EAU CLAIRE, WIS.—The new power plant of the Chippewa Valley Electric Railway & Power Company at Menominie has been completed and will soon be placed in operation. When the plant is put in operation electricity will be transmitted to the power station in this city. The new dam at Menominie has been completed and will be capable of developing 10,000 hp.

CRANDON, WIS.—Otto Eckhoff, of Wittenberg, is contemplating installing an electric light system for street, residence and commercial lighting and will soon submit a proposition to the Council, and if granted a franchise, will erect a modern lighting system in the town.

GREEN BAY, WIS.—The City Council, on Oct. 19, adopted a resolution to award the contract for lighting the city to the Green Bay Gas & Electric Company at $70 per lamp per year.

WATERLOO, WIS.—The city has taken over the local electric light plant and is preparing plans for the construction of a power house in which to place the plant and electric equipment already purchased. A bond issue of $10,000 was made recently to provide for this improvement.

EDMONTON, ALB.—R. R. Keely, general manager of the municipal electric railway system, writes that a 1000 producer gas engine is now being installed in the power plant.

EDMONTON, ALB.—The Commissioners are considering the purchase of the street railway franchise from the town of Strathcona. If negotiations are successful the two systems will be operated under one corporation. Address Mayor Mills, Edmonton, Alberta.

STRATHCONA, ALB.—A schedule of charges has been made for electricity by the manager of the municipal electric light and power plant. To consumers using less than 100 kw the charge will be 14 cents per kw-hour with a sliding scale up to 600 kw, when the charge will be 5 cents per kw-hour.

KELOWNA, B. C.—R. Morrison, city clerk, writes that the proposed $40,000 water and electric light bonds to be issued have not yet been sold.

PENTICTON, B. C.—The ratepayers are discussing the advisability of installing an electric lighting plant. Address the Mayor.

VANCOUVER, B. C.—City Electrician McCrossan has resigned. The City Council has decided to advertise for applicants for the position. Address Mayor Bethune.

VANCOUVER, B. C.—Hon. Maurice Gifford, one of the directors of the British Columbia Electric Street Railroad Company, announces that the company will spend $1,500,000 next season in extensions and improvements. Address R. H. Sperling, general superintendent, Vancouver.

VANCOUVER, B. C.—W. J. Sutherland, 11 Old Broad Street, London, England, has been in the city in connection with the Alaska Perseverance mine near Juneau, Alaska. This mine will be operated by electricity. The company will generate 40,000 hp, of which 12,000 will be used at the mine, the balance being transmitted to the mines at Silver Bow Basin.

BRANTFORD, ONT.—General Manager Verner, of the Grand Valley Radial Company, has announced changes which will be made on the transfer of interests to the new company of Pittsburg capitalists. The Brantford Street Railway will be thoroughly overhauled and loop lines extended to Eagle Place and Terrace Hills, and a line will also be built to Cainsville, three miles east. A new line will be constructed to the south to Port Dover, on Lake Erie, a distance of thirty miles. The road from Brantford and Galt will be reconstructed and new rails laid, and a spur will be built to St. George. From Brantford a new line will also be constructed west via Burford and Cathcart to Woodstock, where the Thames Valley Road, which has been acquired, will be used to Ingersoll.

FORT FRANCIS, ONT.—Work on the large power dam will be resumed very shortly and will be under the management of G. J. Huss, chief engineer of the Minnesota & International Railroad, which is building to International Falls on the American side of the river. He states that work will be rushed on the power development, especially on the Canadian side.

HAMILTON, ONT.—The Cataract Power Company has announced a reduction in its rates for domestic lighting, commencing Dec. 1. The rate is now 10 cents per kw-hour. After Dec. 1 the rate will be graded from 5.94 to 7.65 cents per kw-hour, according to the consumption. The company will renew all lamps free of charge, but will continue to charge a rental of 25 cents a month for meters, and will refuse to renew its flat-rate contracts. For commercial purposes the rate will be 4½ cents per kw-hour in addition to a fixed charge, depending on the kind and size of lamps used.

LONDON, ONT.—The City Council on Oct. 21 voted to instruct the city engineer to make estimates of the cost of a distributing plant for Niagara Falls power.

MARKHAM, ONT.—The citizens on Oct. 22 voted in favor of a by-law providing for $3,000 for extensions to the municipal electric light plant.

PORT ARTHUR, ONT.—The town has awarded the contract for the development of electrical energy at Dog Falls to Kerry, Smith & Chance, Confederation Life Building, Toronto. About 30,000 hp will be developed at an approximate cost of $800,000. John McTeigue is city clerk.

NIAGARA FALLS, ONT.—Fitzgerald & Bennie, the Canadian representatives of the American Electrical Furnace Company, have arranged with the Canadian Niagara Power Company to supply electricity to a plant to be constructed at Niagara Falls, Ont., not only for the demonstration of the utility of the present methods, but also for investigation into improvements of melting metal by electricity. At first an 80-hp furnace of the Colby type will be set up. This furnace at the Flerton Saw Works in Philadelphia, furnished ingots of metal weighing 70 lbs. with an expenditure of 34 to 54 hp, according to the composition of the steel. From England will be brought a furnace of the Kjellin type which will require energy of 200 hp. This furnace, when installed at the plant, will be supplied from the Canadian Niagara Power Company's line. The furnace will yield 1000 lbs. of steel at a single heat and has a capacity of six heats in twenty-four hours. A crane of 5 tons capacity is being built for the plant by the Niagara Falls Machine & Foundry Company.

ST. CATHARINES, ONT.—The Dunnville Consolidated Telephone Company has purchased the poles, wires and all other outside equipment of the Bell Telephone Company in this territory except what is reserved for long-distance service, and after Nov. 1 the Bell company will cease to maintain a local exchange in this place or to do business in the territory covered by the Dunnville company, which includes the entire county of Haldimand and adjacent sections.

TORONTO, ONT.—A proposition for the development of water power at Milleroches, on the St. Lawrence River, at a cost of $20,000,000, was submitted Oct. 24 to the International Waterways Commission for its approval by the St. Lawrence River Company, of Canada, and the Long Sault Development Company. The Canadian company proposes to spend $5,000,000, having already expended $1,000,000, and the American company is to invest $15,000,000. It is proposed to develop power at the lower end of Barnard Island, where both companies would work together. The St. Lawrence company at present supplies Cornwall with electricity. Its present plant has a capacity of 1200 hp and the new plan provides for 50,000 hp. The St. Lawrence company was represented by George Foster, K. C., of Montreal, Que., president of the company, and L. G. McCarthy, M. P., and the American company by Arthur V. Davis, of Pittsburg, Pa.; W. F. Rickey, of Massena, N. Y., and E. B. Freeman, of Hartford, Conn.

TORONTO JUNCTION, ONT.—The Town Council has awarded the contract for street lighting to the Stark T. L. & P. System, Ltd., for a term of three years at the rate of 9 cents per lamp per night. The company holds the present contract for furnishing street lamps. The Electric Development Company, which submitted a proposition to furnish street lighting on the same terms as was accepted from the Stark system, asked for permission to furnish electricity to private corporations in the town for manufacturing purposes, which was referred to a special committee.

WOODSTOCK, ONT.—A company is being formed here for the purpose of building a telephone system. Already over $5,000 worth of stock has been subscribed. Address D. Holyoke, secretary, Woodstock, Ont.

BATTLEFORD, SASK.—The contract for the erection of the power house here in connection with the municipal plant has been awarded to W. J. Broley. The arrival of poles is delaying the work, but it is hoped to have the power in use by the latter part of December.

FORT SASKATCHEWAN, SASK.—The civic power plant was recently destroyed by fire.

Company Elections.

HARTSELLS, ALA.—At a meeting of the stockholders of the Hartsells Electric Light & Power Company, held recently, the following officers were elected: J. J. Curley, president; J. Leydon Day, secretary and treasurer. The board of directors consists of J. L. Day, M. D. Wiggins, J. C. Rogers, J. R. Sample and J. J. Gould. A purchasing committee was also elected and a plant will be purchased and installed at once.

BUCYRUS, OHIO.—At the annual meeting of the Marion Bucyrus Railway & Light Company, held Oct. 14, the following directors were elected: Francis L. Judd, William Duke, E. C. Braun, F. W. Long, Frank S. Pelton and A. C. Shoeman. The control of the company has been purchased by Messrs. Duke and Judd and their associates. The company will push the work of construction of the road to completion, when it will be taken over by the Marion-Galion Electric Railway Company.

New Industrial Companies.

THE ADVANCE ENGINE & MANUFACTURING COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $25,000 by H. O. Coughlin, A. C. Bear and John R. Turner. The company proposes to manufacture motors and automobiles.

THE F. ALEXANDER ELECTRIC & MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000. The directors are Louis Liebes, Hannah Liebes and F. Alexander, of New York, N. Y.

THE ATLANTIC ELECTRIC GOODS COMPANY, of Jersey City. N. J., has been incorporated with a capital stock of $40,000 for the purpose of manufacturing electrical appliances. The incorporators are: Russell Dart, William S. Brown and Franklin Nevius.

THE ELECTRIC EQUIPMENT COMPANY, of Memphis, Tenn., has been incorporated with a capital stock of $10,000 by Fred Clayton, W. S. Counsell, J. H. Short, W. B. Morgan and George H. Harsh.

THE ELECTRO-GALVANIZING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $2,400. The directors are: Louis J. Aul, L. Louis Salant and Samuel Fischer.

THE NATIONAL ELECTRIC COMPANY, of Indianapolis, Ind., has filed articles of incorporation with the Secretary of State. The object of the company is to erect, equip and operate a plant for the manufacture of electrical apparatus, equipment and supplies and to do a general business of installing light and power plants. Henry C. Schildmier, C. B. Campbell and R. O. Balsey are the directors.

THE ST. LOUIS ELECTRIC HEATING COMPANY, St. Louis, Mo., has filed articles of incorporation with a capital stock of $10,000. The object of the corporation is to manufacture and deal in machinery for generating and transmitting electric heat, etc. The incorporators are: Joseph H. Beckwith, Henry C. Beckwith and James A. Hawze.

THE THOMAS BATTERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 by Dr. Julian P. Thomas, Thomas S. Witherbee and Frederick T. McIntyre.

New Incorporations.

LOUISVILLE, ALA.—The Louisville Light & Water Company has been incorporated with a capital stock of $20,000 by W. L. Strong and others.

GOSPORT, IND.—The Gosport Electric Light & Power Company has filed articles of incorporation with the Secretary of State. The company proposes to build, equip and operate an electric light and power plant to generate and distribute electricity for light, heat and power purposes. W. A. Montgomery, J. S. Davis and J. C. Brown are the directors.

NEW YORK, N. Y.—The Southern Power Company has been incorporated with a capital stock of $1,000. The directors are: William O. Spring, Tompkinsville, S. I.; Frank S. Wright and St. Julien Grimke, of New York.

MILLERSBURG, OHIO.—The Millersburg & Eastern Railroad Company has been chartered with a capital stock of $1,000,000 by O. S. Olmstead, D. M. Miller and W. W. Adams, of Millersburg, and Samuel P. Dunn and J. A. Burke, of Cleveland. The company proposes to build a line between this city and Beach City, a distance of 26 miles. The capital stock is to be increased to $500,000 later on.

PUTNAM, OKLA.—The Citizens' Light & Power Company has been organized with $250,000 capital stock to build an electric light plant at Putnam and later to enter Oklahoma City. The officers are: C. G. Jones, president; W. H. Philips, vice-president; W. L. Peck, treasurer; W. E. Grisby, secretary, and F. H. Peck is general manager, who will have charge of the erection of the plant.

ERIE, PA.—A charter has been granted to the East Erie Connecting Railroad to construct a line 2½ miles long in the suburbs of Erie. The company is capitalized at $25,000. Matthew C. Griswald is president of the company.

SYKESVILLE, PA.—A charter has been granted to the United Traction Extension Company to build an electric railway 7 miles in length over private right of way from this town to Big Run. The company is capitalized at $1,000,000 and the directors are: Austin Blakeslee, president; J. B. Sykes, Frank Hahne, M. I. McCreight, W. H. Cannon, J. E. Merris and W. C. Newcome.

TARENTUM, PA.—The Butler, Saxonburg & Tarentum Electric Railway Company has been chartered with a capital stock of $50,000 to construct an electric railway from Tarentum to Saxonburg and Butler, 24 miles in length. The directors of the company are: Joseph Cirighano, president; Emil T. Rudert, Edward C. Rudert, John E. Winder and Otto W. Rudert, all of Saxonburg.

MOUNT VERNON, VA.—The Vernon Telephone Company has been incorporated with a capital stock of $5,000 to construct a telephone system in Carroll County. The officers of the company are: S. W. Worrell, president; A. W. Alderman, vice-president; G. H. Alderman, of Ethelfelts, secretary.

TOPPENISH, WASH.—Articles of incorporation have been filed for the Toppenish Electric Light & Power Company. The company is capitalized at $15,000, and the trustees are E. F. Bohannon and G. G. Lee. The company was recently granted a franchise and will begin work at once on a plant, which will be in operation within a year.

RICHMOND, WIS.—The Richmond Telephone Company has been incorporated with a capital stock of $2,500 by John D. Clark and others.

VANCOUVER, B. C.—The British Columbia Electric & Power Company has been organized here with local capital to develop 250,000 hp at a canyon on the Chekamus River, 48 miles from this city. At the power site the river has a drop of 520 ft. in 600 ft.

Obituary.

MR. LEROY B. FIRMAN, inventor of the telegraph fire-alarm system and the messenger call box, died recently at Anaconda, Mont. He was 74 years old. For years he was associated with Thomas A. Edison and Alexander Bell. He was the organizer of the American District Telegraph Company.

Personal.

DR. LOUIS BELL is the author of a paper in the September issue of the *Proceedings of the American Academy of Arts and Sciences*, entitled "The Physiological Basis of Illumination."

PROF. A. F. NESBIT, of New Hampshire College, is the author of a text-book entitled "Theoretical and Applied Electricity and Magnetism for Junior Students," which will shortly be published.

MR. H. H. PORTER.—The announcement has been made by the Interborough-Metropolitan Company of the appointment of Mr. H. Holbert Porter, member of the firm of Sanderson & Porter, engineers, New York City, as consulting engineer.

MR. R. R. SMITH, general manager of the Evansville & Southern Indiana Traction Company, of Evansville, Ind., has resigned to accept the position of manager of the Louisville Traction Company, of Louisville, Ky.

MR. O. H. FALK, vice-president of the Falk Manufacturing Company, of Milwaukee, Wis., has been elected a member of the board of directors of the Wisconsin Telephone Company to fill the vacancy caused by the retirement some months ago of Mr. Ira B. Smith.

MR. JAMES C. HOWE, manager of the Missouri & Kansas Telephone Company, in St. Joseph, Mo., has resigned and will leave the company's service Nov. 1. He will go to Kansas City to take the position as manager of an Eastern brokerage firm. His successor has not yet been appointed.

PROF. C. L. DEMURALT, of the electrical engineering department at the University of Michigan, at Ann Arbor, Mich., has been appointed consulting engineer to the state railways of Austria in connection with the electrification of the Arlberg tunnel under the Tyrolean Alps. The tunnel is 7 miles long.

MR. CHAS. W. BURKETT, for four years chief engineer of the Wisconsin Telephone Company, has resigned in order to accept a similar position with the Pacific States Telephone & Telegraph Company. His new headquarters will be in San Francisco, and he will assume his new duties before Jan. 1.

MR. EDWARD CALDWELL has been appointed chairman of the Library Committee of the American Institute of Electrical Engineers and has assumed the duties of the position. The joint library in the Engineering Societies Building is daily assuming larger proportions, and there are growing demands upon its resources.

MISS C. BECKWITH.—The many friends of this well-known technical journalist, who broke down recently at her desk from overwork, will be glad to learn that a very rapid recovery has been made and that early restoration to full health is now expected by the medical attendants, who have ordered meantime complete rest and quiet.

MR. G. MARCONI having put his wireless system into commercial operation across the Atlantic is proceeding immediately to England. He hopes, however, to return soon to the United States and to have the opportunity of presenting a review of his work this winter before the American Institute of Electrical Engineers.

MR. NATHANIEL P. CRAIGHILL has been appointed professor of electrical and mechanical engineering at the University of Montana, Missoula, Mont. Prof. Craighill carries to the position a wide experience in the fields of electrical and mechanical engineering, extending over the designing, construction and manufacturing branches, and at one time was associate editor of the *American Electrician*.

MR. THEODORE I. JONES, manager of the sales department of the United Electric Light & Power Company of New York, is delivering for the local board of education in its popular public courses a series of eleven lectures on illuminating engineering. These will be given at the Harlem branch of the Y. M. C. A. each week until about Christmas. Each lecture is illustrated by burning illuminants and by lantern slides.

MR. DAVID B. CARSE has resigned from the chairmanship of the advisory committee of the United States Steel Corporation, and will resume the management of the business of Carse Brothers Company, which company has been reorganized and headquarters transferred from Chicago to 12 Broadway, New York. The firm will continue to deal in machinery and supplies for railroads, with a department of electrical specialties added.

MR. BYRON T. BURT, manager for the Chattanooga (Tenn.) Light & Power Company, has resigned his position to take up other work for the General Electric Company, which controls the property. He has been succeeded by Mr. W. E. Boileau, a capable electrical engineer and man of affairs, who supervised the recent turbine installation, and is familiar with details of the system. Mr. Burt was several years in Chattanooga and leaves a fine record behind him.

MR. W. J. HARVIE, who for some time has been electrical engineer of the Utica & Mohawk Valley Railway Company, Utica, N. Y., has been promoted to the position of chief engineer of the Utica & Mohawk Valley Railway Company, the Oneida Railway Company and the Syracuse Rapid Transit Railway. For the present Mr. Harvie will remain in Utica. Mr. H. S. Williams, who has been Mr. Harvie's assistant, succeeds him as electrical engineer of the Utica & Mohawk Valley Company.

MR. JOHN A. BRITTON, vice-president and general manager of the Pacific Gas & Electric Company, of San Francisco, delivered a lecture on Oct. 16 before the Associated Mechanical and Electrical Engineers of the University of California. His subject was "Engineering Possibilities in California," and he reviewed briefly the wonderful progress of electrical and gas engineering in that state in the last twenty years, pointing out openings for men in various lines. He made special mention of the opportunity in gas engineering, in which but one college, the University of Michigan, now offers instruction. At the close of his address Mr. Britton described the Martin gas engine station of the California Gas and Electric Corporation, illustrating its different features by means of lantern slides. Mr. Britton is a member of the Board of Regents of the University of California.

MR. P. T. DODGE, president of the Mergenthaler Linotype Company, and active in the management of both the Electric Vehicle Company and the Electric Storage Battery Company, is the subject of the following "Pen Point" sketch in the *Wall Street News:* "Mr. Dodge, who has just been elected to the executive committee of the Graphophone Company, may be truthfully termed the printers' fairy Godfather, for it is he who has done so much to make possible and popular the Linotype, which enables type to be set while you wait and the news to come hot off the press. Graduated from Columbia University, a very excellent foundation for his very excellent business career. His new position makes him, with the ones he already holds, the monarch of sight, sound and space, all three things of which he has done much to control and popularize. Six directorships and eleven clubs occupy his time and attention."

MR. RICHARD T. LAFFIN, vice-president and general manager of the Manila Electric Railroad & Light Company, has resigned, having completed the task of establishing the operating organization of this property on a sound earning basis. The management is now assumed by Mr. C. B. Graves, who has been Mr. Laffin's right hand man since the property was placed in operation, three years ago, officiating as manager of the lighting and power department. Mr. Laffin is still interested financially in the Manila properties, and resigns to take the management of another group of public utility properties in which J. G. White & Company, Inc., are largely interested. It is considered by Mr. Laffin and J. G. White & Company, operating managers of the Manila Electric Railroad & Light Company, that Mr. Graves is well qualified to continue the successful administration and maintain the policies inaugurated by Mr. Laffin, which have made the Manila company so successful. Mr. Graves has extended experience in the management of electrical plants in the tropics. At one time, before becoming connected with the Manila Electric Railroad & Light Company, he was electrical engineer and assistant manager of the extensive system of the Sao Paulo Tramway Light & Power Company, Sao Paulo, Brazil.

PROF. W. F. M. GOSS.—The University of Illinois has secured as dean of its College of Engineering and its new School of Railway Engineering and Administration Prof. William Freeman Myrick Goss. He was born in Barnstable, Mass., in 1859, graduated from the Massachusetts Institute of Technology in 1879, and went immediately to Purdue University, Lafayette, Ind., to organize a practical department of mechanics, of which he has ever since been the head. Professor Goss has specialized along the line of the investigation of motive power. He was the pioneer in locomotive testing and designed the locomotive testing plant at Purdue, which has been copied by the Pennsylvania Railroad at Altoona. He is a member of the American Society of Mechanical Engineers, of the Association for the Promotion of Engineering Education, the Western Railway Club, American Master Mechanics' Association, American Master Car Builders' Association, International Association for Testing Materials, and Fellow of the American Association for the Advancement of Science. He served as a member of the advisory committee of the United States geological survey in testing fuels and structural materials, on the jury of awards, Columbian Exposition of 1893, advisory committee of the Pennsylvania Railroad Company in testing locomotives at St. Louis in 1904, and has recently been chosen to carry on special investigations relating to superheated steam for locomotives by the Carnegie Institute of Washington. He has written several valuable books relating to locomotive works and has contributed freely to the technical press. Professor Goss expects to take up his work at Urbana on Nov. 1.

MR. G. S. RICE.—After Dec. 1 Mr. George S. Rice will no longer be the chief engineer of the Public Utilities Commission. The resignation of Mr. Rice, to take effect on the date mentioned, and the appointment of Henry B. Seaman as his successor, was announced last week. Mr. Rice will continue in the service of the commission as assistant engineer in charge of construction work. The salary of Mr. Rice has been $15,000. As first assistant he will receive $10,000 a year. Mr. Seaman's salary will be $15,000. Mr. Seaman is a native of New York and graduated from Swarthmore College, Pennsylvania, in 1881. He spent a year doing engineering work for the Erie Railroad Company, after which he entered the employ of the Edgemore Bridge Company. A year later he became associated with the engineering force of the Kings County Elevated Railroad Company, a subsidiary concern of the B. R. T. Following this he was connected with the bridge department of the Pennsylvania Railroad Company, and afterward was assistant engineer of

the firm of Wilson Brothers, of Philadelphia. Later Mr. Seaman returned to the Erie and had much to do with the construction of new bridges along that line between New York and Buffalo. For a while following this he was a construction superintendent for the New York, New Haven & Hartford Railroad Company, and at the time the present subway was built he was employed as an engineer by the contractor for the Fourth Avenue section. He is now a consulting engineer in the Bridge Department of this city and will remain in that position until Dec. 1. He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Engineers' Club, the American Institute of Mining Engineers and the Brooklyn Engineers' Club.

Trade Publications.

BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., have issued a very neat little vestpocket book of data on locomotives. It is bound in leather, well printed, and has been in great demand, especially in connection with the exhibit at the Jamestown Exposition.

BROWNHOIST LOCOMOTIVE CRANES are the subject of an illustrated pamphlet just issued by the Brown Hoisting Machinery Company, Cleveland, Ohio. They are intended for use with Brown grab buckets for handling ore, coal, limestone, slag, etc.

TOBIN BRONZE is the title and subject of a neat little pamphlet issued by the Ansonia Brass & Copper Company, of 99 John Street, New York, the sole manufacturer of this specialty. Full details are given as to the applications and uses of this alloy in its various forms of rod, bar, bearings, plates, etc.

CONDUIT WIRING.—The Sprague Electric Company has issued a new and revised edition of its Conduit Bulletin No. 421, which describes the Greenfield flexible steel conduit, flexible steel-armored conductors and steel-armored flexible cord. The bulletin also includes notices of outlet boxes, fittings and tools.

WOOD PRESERVATION.—The C. A. Manufacturing Company, Austin, Texas, presents in pamphlet form numerous testimonials from electric light, railway and telephone companies commending the use of "carbolineum America" for the preservation of wood poles. This composition is manufactured in Mannheim, Germany, and distributed in this country by the above-mentioned firm from St. Louis, New Orleans, San Francisco, Salt Lake City and Galveston.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is sending out a flyer on "Portable Lamps" which shows some very attractive portable lamps as gifts for the holiday season. The company has for some years devoted considerable attention to the fixture department, and this year special attention has been paid to this branch of its business and to lamps for the holiday season. This flyer calls attention to the company's display rooms and if the lamps which are shown are anything to judge from, prospective buyers would be well paid by visiting these show rooms in person. The Central Electric Company will gladly mail a copy of this flyer on request.

TRUMBULL LITERATURE.—The November cover of "Trumbull Cheer" illustrates the general two-color design adopted by this "magazinette, published each month" (if it's lucky), by the Trumbull Electric Manufacturing Company, of Plainville, Conn. The primary object of this clever publication is, of course, to put forward the new lines of Trumbull material, which are continually offered the trade and to re-emphasize the merit of other material already published. This is done by the publishing of regular price lists with cuts and discounts, and also by articles of more or less technical nature setting forth various matters arising in the manufacturing field that are of direct interest to the contractor, jobber and purchasing public in general. In this November issue appears an article on the recent rulings of the Underwriters, covering switches for alternating-current work; also a detailed list of Trumbull's "A" line of switches, showing that prices for 27,840 different type "A" switches are given in its bulletin. Its panel boards and switchboards are also advertised. The whole tone of the little magazine, as the title indicates, is cheerful, numerous epigrammatical sayings being introduced with catchy verses and reflections on business and general conditions. It is printed throughout in two colors on heavy coated paper and illustrated with caricatures and half-tone cuts, which produce a decidedly pleasing effect. The trade is urged to follow this publication carefully, as prices are changing, new lines are being continually introduced and old lines extended. Copies will be gladly sent upon application to all those interested in electrical developments.

Business Notes.

THE TREMAINE ELECTRIC COMPANY, of Brockton, Mass., has moved into its new store located at School Street and City Hall Square, where it will carry a line of electrical and gas fixtures and auto supplies.

THE STEEL CITY ELECTRIC COMPANY, Pittsburg, Pa., has purchased the outlet box business of the Sarco Company, New York, including patent rights, tools, machinery and stock of goods. Orders for Sarco outlet boxes can be fulfilled promptly.

TRANSFORMERS FOR TRANSATLANTIC WIRELESS.—In last week's issue we published an account of the opening of the Marconi transatlantic wireless telegraph service between Glace Bay, N. S., and Clifden, Ireland. It is interesting to note in this connection that the transformers used at both of these stations are of American make, having been supplied by the American Transformer Company, of Newark, N. J.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., has established a district office at Pittsburg, Pa., in charge of Mr. C. A. Poe, formerly of C. A. Poe & Brother. The office is conveniently located at 618 Park Building. Northern customers and others desiring to consider Northern machines will find the Pittsburg office in position to act promptly on inquiries for information or assistance. Mr. Poe is not unknown to Northern customers in the Pittsburg district, having represented the company in conjunction with other lines for several years. His entire attention is now devoted to the Northern work.

RAILWAY INSULATORS.—Mr. Louis Sternberger, president and general manager of the Electrose Manufacturing Company, Brooklyn, N. Y., writes as follows: "Your issue of Oct. 5 contains an article under the heading, 'Electric Traction in Belmont Tunnel.' Referring to the overhead third-rail insulators the article states, 'The rail inverted is suspended from molded mica insulators, etc.' Permit us to inform you that that statement is erroneous. The overhead third-rail insulators installed in the Belmont tunnel are electrose insulators. It may interest you to learn that exhaustive and competitive service tests were instituted by the engineers of the Interborough Rapid Transit Company on third-rail insulators made by various manufacturers, and after a period of thirteen months of constant use in regular service, under the severest possible conditions, Electrose insulation won out against all competitors, and as a result we were awarded the contract for the overhead third-rail insulators for the Belmont tunnel. Electrose insulation, wherever adaptable, fulfills all requirements in a highly satisfactory manner."

CHICAGO ELECTRICAL SHOW.—Space for the third annual Electrical Show to be held in Chicago, Jan. 13-25, 1908, is being eagerly sought by all lines of electrical manufacturers. The management announces that more than two-thirds of the available space has already been taken, and by reason of the unusually enthusiastic interest that has already been shown in this annual affair, the largest and most striking show ever held is assured. A feature of this year's show that will make it attractive is the scheme of booth construction, decoration and decorative lighting that has been arranged for. D. H. Burnham & Company, the well-known achitects, have been engaged to design the entire installation, and have planned it on a scale in keeping with the high character of the exhibits, giving them a setting that will greatly enhance their value and effectiveness. This is a radical departure from previous shows, and will be appreciated by exhibitors who will be relieved of a great deal of work and worry incidental to the preparation for their exhibits in previous shows. All booths, railings, signs, wiring, etc., will be installed by the Exposition Company.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutical Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, New York, December 3-6, 1907.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 7, 1907.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS & ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New England, Philadelphia, Pittsburg and Chicago. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles West. Next meeting, Chicago, January 21, 22 and 23, 1908.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn. Next meeting, Chicago, January 21, 22 and 23, 1908.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Charles W. Ford, Oklahoma City, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 22, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

868,648. SEMAPHORE SIGNAL; Fred B. Corey, Schenectady, N. Y. App. filed March 27, 1907. Mechanical and electrical features of construction of a motor-driven semaphore, with a stop-motion switch by which the motor is controlled.

868,650. EXPRESSION MECHANISM FOR SELF-PLAYING INSTRUMENTS; George H. Davis, West Orange, N. J. App. filed April 18, 1905. The keys of the instrument have depending levers projecting in proximity to a continuously rotating cylinder and adapted to be pressed into contact therewith by electromagnets.

868,651. INSULATED METAL CROSS TIE; Alva C. Dinkey, Pittsburg, Pa. App. filed Dec. 31, 1906. Metallic cross-ties with a bushed riveted connection to the track rails.

868,664. PROCESS OF MAKING RAIL BONDS; Albert B. Herrick, Ridgewood, N. J. App. filed May 5, 1904. A process of manufacturing rail bonds which consists in forming the bond strands into the desired shape, and then fitting solder strips over the portions of the same that are to be used for the terminals of the bond.

868,670. ELECTROLYSIS OF FUSED ALKALINE CHLORIDS; Franz von Kugelgen and George O. Seward, Holcombs Rock, Va. App. filed June 13, 1905. The process which consists in electrolyzing a mixture of an alkaline chlorid with a fluorid of higher decomposition voltage.

868,674. ELECTRIC SIGN; Carl O. Lindstrom, Chicago, Ill. App. filed April 7, 1906. Relates to sockets for electrically operated signs, and aims to provide a structural formation by which the ordinary socket can be adapted to illuminate the face of a sign in any desired plane.

868,696. SELF-WINDING ELECTRIC CLOCK; Arthur F. Poole, Wheeling, W. Va. App. filed Jan. 24, 1906. Relates to self-winding clocks of the type rewound at proper intervals by mechanical means brought into action by the automatic closure of an electrical circuit.

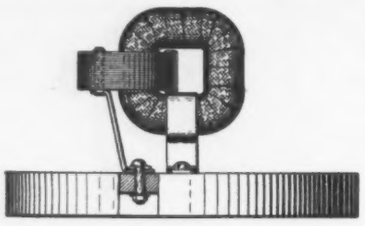
868,723. CONTROL OF MOTOR-OPERATED DOORS; David W. Taylor, Washington, D. C. App. filed May 14, 1906. Relates to the control of bulkhead doors which are designed to be simultaneously closed from a distant point or individually controllable at the local point. Provides means by which the man at the door can take the control away from the distant operator as long as he has his hand on the controller.

868,729. BATH FOR OBTAINING ELECTROLYTIC METALLIC DEPOSITS; Leopold Trunkhahn, Vienna, Austria-Hungary. App. filed June 4, 1906. A bath for producing electrolytic metallic deposits comprising one or more sugars and a ferment.

868,740. ELECTRICAL PIANO-PLAYING ATTACHMENT; Joseph Weber, Brooklyn, N. Y. App. filed Sept. 14, 1905. Provides a frame or housing for the actuating and controlling devices comprised in a self-playing attachment for pianos, such housing being arranged to occupy a minimum amount of space when the apparatus is put away beneath the keyboard.

868,751. ELECTRICAL CONNECTORS; Frederick H. Ayer, Chicago Heights, Ill. App. filed Feb. 23, 1907. The bond connector wire has a three-sided transverse section of such a character that it co-operates with a notched tapering plug to completely fill a circular-drilled hole in the rail web.

868,752. VARIABLE REACTIVE COIL; Ralph E. Barker, Lynn, Mass. App. filed Jan. 23, 1907. Construction of coils of variable reactance for regulating the voltage supply to alternating current devices. Has



868,752.—Variable Reactive Coil.

a core forming a closed magnetic circuit of varying cross-section, and a winding thereon, the core and winding being relatively adjustable.

868,769. PROCESS FOR THE RECOVERY OF NICKEL FROM ORE; Charles H. Ehrenfeld and Jacob R. Grove, York, Pa. App. filed Jan. 27, 1906. Relates to processes by which metal is completely exhausted from an ore and incorporated into a suitable solution by electrolysis at the anode, being deposited in metallic form upon the cathode.

868,780. TROLLEY WHEEL GUARD; Charles Harkness, Providence, R. I. App. filed Feb. 16, 1905. Patentee has a pair of arms swinging on each side of the trolley harp and carrying at their extremities convex rollers.

868,781. ELECTRIC SWITCH; Chester S. Hill, Williamsport, Pa. App. filed July 16, 1906. The car carries a specially shaped magnet depending in close proximity to the ground and which causes the magnetic actuation of certain circuit closing devices in the track bed when energized.

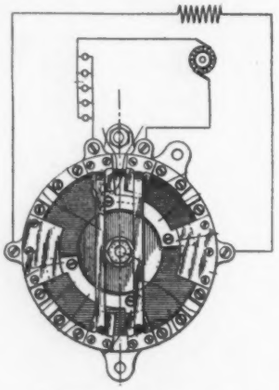
868,806. ELECTRIC MOTOR; Oscar H. and Alphonse F. Pieper, Rochester, N. Y. App. filed Nov. 25, 1905. Relates to a governor controlling apparatus for an electric motor for keeping it at constant speed.

868,864. ELECTRIC-CONTROLLING SYSTEM; Ray P. Jackson, Wilkinsburg, Pa. App. filed Nov. 23, 1904. Provides means for preventing a circuit breaker of a system from closing after it has been caused to open by an overload on the motors until after the reversing switch has been moved to its off position.

868,880. SOUND TRANSMITTER AND RECEIVER; Arthur J. Mundy, Boston, Mass. App. filed April 23, 1902. Has a globular shell sunk beneath the surface of the water in submarine signaling, and which contains sensitive transmitters adapted to operate with telephone receivers at a distant point.

868,889. TROLLEY-OPERATING VALVE; Robert H. Rogers, Schenectady, N. Y. App. filed Nov. 17, 1905. A pneumatic apparatus for controlling the shoes or trolleys and for electric locomotives.

868,911. ELECTRIC RAILWAY SYSTEM; John L. Crouse, New York, N. Y. App. filed Dec. 29, 1904. Relates to electric railway systems which employ both trolley and third-rail conductors alternately used



868,968.—Pole Changer.

at different points of the system. Covers electrical means for controlling the respective shoes or collectors.

868,929. ELECTRIC-CONTROL SYSTEM; Ray P. Jackson, Wilkinsburg, Pa. App. filed April 3, 1905. Provides a means for retaining the reversing switch in closed circuit position after it has been moved to that position until after the circuit breaker is opened.

868,933. TELEPHONE EXCHANGE; Frank A. Lundquist, Chicago, Ill. App. filed May 20, 1904. Mechanical features and electric circuits of automatic exchange.

868,967. AUTOMATIC TOOL-OPERATING DEVICE; Arthur Clemons and David W. Pelkey, Chicago, Ill. App. filed Oct. 9, 1906. An electric tool having a reciprocating part impelled alternately by a pair of solenoids, the circuits of which are completed by plunger switches.

868,968. POLE CHANGER; Walter H. Cotton, Chicago, Ill. App. filed Aug. 6, 1906. A pole changer for reversible dynamos having a reversible wheel with a recess in its periphery and an oscillatable member having a lost motion connection with the switch and engaging the wheel at said recess.

869,012. FILAMENT FOR INCANDESCENT LAMPS; E. McOuat and H. W. F. Lorenz, Amsterdam, N. Y. App. filed June 29, 1904. The process of making incandescent filaments which consists in dipping a carbonized core in a caramel solution containing finely divided metallic light-emitting particles in mechanical suspension whereby a coat is deposited on said core through which said particles are dispersed, and carbonizing said coat to render said coat and said particles integral with said core.

869,013. INCANDESCENT FILAMENT AND PROCESS; E. McOuat, et al., Springfield, Ohio. App. filed Dec. 6, 1905. The process of making incandescent lamp filaments which consists in incorporating a metal and silicon in the filament and forming a silicid by reaction between the metal and the silicon components.

869,014. ELECTRIC FIRE ALARM; John A. Obester, Passaic, N. J. App. filed April 25, 1907. Relates to apparatus for detecting the location of fire in buildings and includes a thermometer which closes a circuit ringing an alarm bell at a plurality of points.

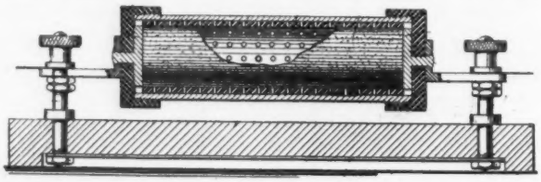
869,018. CLAMP INSULATOR; George Pollock and William E. Werd, Deer Lodge, Mont. App. filed May 9, 1907. Type of insulator made on halves and adapted to exert a leverage upon a wire so as to grip it tightly in position as well as to insulate it thoroughly from surrounding parts.

869,027. ELECTRIC RAILROAD; William G. Spiegel, New York, N. Y. App. filed July 17, 1906. A sectionally energized third-rail thrown into circuit in advance of the train and disconnected after the passage of the train. Relates particularly to the method of avoiding sparking.

869,031. LIGHTNING ARRESTER; Clark I. Stocking, Hiawatha, Kan. App. filed Jan. 3, 1907. Construction of lightning arrester designed to be dust and moisture proof.

869,060. ELECTRIC LINE FUSE; Frank B. Cook, Chicago, Ill. App. filed Oct. 8, 1906. Provides construction of terminals for a fuse of the enclosed type, which are made of sheet metal, and so designed that the fuse will lie substantially parallel with the line wire when in service on the same.

869,067. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Feb. 16, 1903. In a telephone system, the combination with a plurality of telephone lines, each having a cut-off relay actuated over a portion of the talking circuit, a ringing generator adapted to be connected with a line to call a wanted subscriber, means for maintaining said cut-off relay actuated during ringing, and automatic



869,031.—Lightning Arrester.

means controlled by the called subscriber for disconnecting said generator at the central office, substantially as described.

869,094. METHOD OF PRODUCING SULFURIC ACID; Isidor Kitsee, Philadelphia, Pa. App. filed July 21, 1906. The method of producing sulfuric acid which consists in subjecting a continuous stream of sulfurous gas in the presence of necessary moisture to the action of an electric current adapted to modify the chemical constituents of said gas to convert the same into sulfuric acid.

869,102. DYNAMO ELECTRIC MACHINE; Mathias Pfatischer, Philadelphia, Pa. App. filed July 5, 1907. Provides a construction of magnetic circuit of the commutating field in dynamo electric machines where it is advisable or necessary to create an auxiliary magnetic field for the purpose of effecting good commutation.

869,114. MASSIVE BORON CARBID AND PROCESS OF MAKING SAME; Samuel A. Tucker, New York, N. Y. App. filed Dec. 19, 1906. The method of producing practically pure boron carbon, which consists in bringing a boron compound and carbon in an enclosure to the requisite temperature to produce the reaction, and controlling the pressure within the enclosure.

869,119. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 13, 1902. In a telephone system, the combination with a telephone line, of two line relays therefor, a cord circuit, a pair of supervisory relays associated therewith, and means for connecting said relays in shunt to said line relays when a connection is established with the line.

869,163. INSULATOR; William J. Devine, Norwalk, Conn. App. filed July 23, 1907. A plurality of clips with V-shaped edges which dovetail or rabbitt together and which have grooves for the passage of the conductors.

869,185. SELF-EXCITING ALTERNATING-CURRENT DYNAMO; M. Latour, Sevres, France. App. filed July 9, 1901. In a self-exciting alternating current generator, an armature having a distributed winding, a field having a distributed winding and a many-part commutator, and means for supplying polyphase currents to said field winding through said commutator.

869,186. SHUNT-WOUND SELF-EXCITED ALTERNATOR; M. C. A. Latour, Sevres, France. App. filed Aug. 8, 1903. In combination, an alternating current generator comprising relatively rotatable members, one of which is mechanically driven, and each of which is provided with a distributed winding, polyphase shunt connections joining together said windings to provide paths for currents whereby the generator becomes self-exciting and a load circuit supplied with current from said generator.

869,187. COMPOUNDED SELF-EXCITED ALTERNATOR; M. C. A. Latour, Sevres, France. App. filed Aug. 8, 1903. In an alternating-current generator, a field having a distributed winding connected to a many-part commutator, and means for supplying to the winding polyphase currents taken part in derivation from the armature, and part in series with the line.

869,196. RAILWAY SIGNAL; Robert D. Peters, Knox, Ind. App. filed July 25, 1905. Details of construction of an electrically-operated semaphore signal having a semaphore arm directly connected to the motor shaft which has stops limiting its movement to a quarter of a revolution.